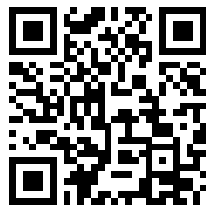

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GIFT OF

The Philippine Agriculturist

(University of the Philippines Publications: Series A)

VOLUME XVI

JUNE, 1927, TO MARCH, 1928

(Complete in ten numbers and a special number)

**PUBLISHED BY THE COLLEGE OF AGRICULTURE
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P 62
v. 16-17

CONTENTS

VOLUME XVI

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NUMBER 1, JUNE, 1927

The Dean replies. CHARLES FULLER BAKER.....	1
Education and agricultural promotion in Japan: III. Research work. B. M. GONZALEZ..	3
Lowering cost of rice production. M. B. RAYMUNDO.....	9
Growing peanuts from cuttings. P. A. RODRIGO.....	13
Study of the Tobacco Growers' Association Inc. of Tuguegarao, Cagayan. PABLO N. MABBUN.....	19
The cost of raising pullets under conditions existing in the College of Agriculture. PEDRO S. PAJE.....	35
Note: Los Baños Biological Club.....	49
Abstract of "Study of the root system of rice." SIMPLICIO OLIVEROS.....	53
Exchange notes from— <i>Extension Letter</i> (University of Hawaii), <i>Successful Farming</i> (Iowa), <i>Cultivator</i> (California), <i>The Directory for Bangkok and Siam</i> (1927), <i>Agricultural Journal</i> (Queensland), <i>Agricultural Society Journal</i> (Jamaica).....	55
College and alumni notes.....	57

NUMBER 2, JULY, 1927

The world's farmers get together.....	65
Education and agricultural promotion in Japan: IV. Promotion of agriculture. B. M. GONZALEZ.....	67
Mañgabol fisheries of Bayambang, Pangasinan. ZOSIMO MONTEMAYOR.....	73
Cost of raising pigs from the time sows are bred until the pigs are weaned. VICTOR T. FELICIANO.....	81
Tillering of rice. DIONISIO CALVO.....	89
Note: The 1927 live stock fair. MARIANO MONDONEDO.....	105
Note: Beekeeping: A prospective industry in the Philippines. CHARLES FULLER BAKER.....	108
Abstract of "The effect of climate upon the production of corn." MATEO D. JIMENEZ... ..	109
Extension division notes.....	110
Exchange notes from— <i>The Planter</i> (Federated Malay States), <i>Agricultural Gazette</i> (New South Wales), <i>Extension Letter</i> (University of Hawaii), <i>Successful Farming</i> (Iowa), <i>Cultivator</i> (California).....	114
College and alumni notes.....	116

NUMBER 3, AUGUST, 1927

"The College of Agriculture in Retrospect".....	119
In retrospect. B. M. GONZALEZ.....	121
Dean Baker's greetings to the student body of the College of Agriculture.....	125
"By their fruits ye shall know them".....	127
Summary of the present occupation of the graduates of the College of Agriculture... ..	160
Alumni of the College of Agriculture.....	161
Students and graduates of the College of Agriculture by years.....	161
Our farmer vanguard.....	165
In illo tempore.....	173
"Then Now".....	178
What they say about Mendiola's book.....	181
From cogonal to teaching plant.....	187
Published contributions for the College of Agriculture arranged by departments....	189

NUMBER 4, SEPTEMBER, 1927

The last rites for Our Dean.....	223
Charles Fuller Baker's final contribution to science. ROBERT L. PENDLETON.....	225
Research and practice.....	227
<i>Pericyma cruegeri</i> (Butler): Its life history and economic importance (Noctuidae, Lepidoptera). HILARIO A. ROXAS.....	229
The cost of producing rice, 1926-27. FRANCISCO M. SACAY.....	235
Some experiments on farm tanning. ILDEFONSO PALISOC.....	253
Abstract of "The effect of leaf cutting upon the production of rice." V. C. LOPEZ.....	267
Extension division notes.....	268
Exchange notes from— <i>The Official Record</i> (U. S.), <i>The Planter and Sugar Manufacturer</i> , <i>The Agricultural Gazette</i> (New South Wales), <i>Reprinted in The Planter</i> (F. M. S.), <i>American Poultry Journal</i> , <i>Cultivator</i> (California).....	272
College and alumni notes.....	274

NUMBER 5, OCTOBER, 1927

The new man at the helm.....	277
What are your answers—yes or no.....	279
Education and agricultural promotion in Japan: V. Stock raising. B. M. GONZALEZ....	281
Some economic phases of rice production in some towns of Laguna. MOISES M. KALAW.	297
Non-gas electrodes for pH determinations. AMADO J. DE LA CRUZ.....	307
Extension division notes.....	323
Exchange notes from— <i>World Agriculture</i> , <i>Journal of the Department of Agriculture</i> (Union of South Africa), <i>The Planter and Sugar Manufacturer</i> , <i>Extension Letter</i> (University of Hawaii), <i>Journal Agricultural Society</i> (Jamaica).....	329
College and alumni notes.....	331

NUMBER 6, NOVEMBER, 1927

The relation between employer and employee. V. G. LAVA.....	337
Progress of tobacco co-operative marketing in Cagayan. PABLO N. MABBUN.....	341
A study of the history, feeding, and management of race horses run under the auspices of the Manila Jockey Club. VALENTIN K. LINA.....	351
Coconut culture in Balbayon Island, Carles, Iloilo. AMADO A. ANDRADA.....	367
Note: An entomological survey of the Pacific. A. L. DEAN (reprinted from <i>Science</i>)....	373
Abstract of "Tenancy in the municipality of San Felipe, province of Zambales. FRANCISCO M. SACAY.....	374
Extension division notes.....	376
Exchange notes from— <i>Tropical Agriculture</i> , <i>Cultivator</i> (California), <i>The Malayan Agricultural Journal</i> , <i>Commerce Reports</i> (U. S. A.), <i>Prairie Farmer</i> (Illinois).....	381
College and alumni notes.....	383

NUMBER 7, DECEMBER, 1927

The glory of the garden. RUDYARD KIPLING (reprinted).....	387
Gardening, an ancient activity (Extracts from article in <i>Gardeners' Chronicle</i> (New York).	388
Observations on range cattle at the Hacienda del Rosario, Cainta, Rizal. VALENTE VILLEGAS AND FELIX B. SARAO.....	391
The sugar cane leaf-hopper, <i>Perkinsiella vastatrix</i> Breddin (Delphacidae, Homoptera). CORNELIO M. URBINO.....	397
The possibilities of cassava production in the Philippines. GETULIO A. GUANZON.....	433
The relation between the tensile strength of an abacá fiber and the length of the individual cells composing it. CONSTANTINO G. DERECHO.....	441
Quadrature parts of conics. MANUEL A. ROA.....	447
Note: A new agricultural journal in India.....	449
Extension division notes.....	451
Exchange notes from— <i>Cultivator</i> (California), <i>The Journal of Agriculture and Horticulture</i> (Canada), <i>Prairie Farmer</i> (Illinois), <i>Experiment Station Record</i> (U. S. Dept. Agric.), <i>Agricultural Gazette</i> (New South Wales), <i>Agricultural Society</i> (Jamaica).....	454
College and alumni notes.....	456

NUMBER 8, JANUARY, 1928

How to get the best out of your job. O. S. M. (The Dawn) (reprinted).....	459
"Every little bit added to what you've got makes a little bit more". CHARLES FULLER BAKER.....	460
Chemical studies on coconut products: I. The critical molding-moisture content of copra, and some methods of preserving it. V. G. LAVA.....	461
An experiment in the use of a grain drill in reducing the cost of planting rice. M. B. RAYMUNDO.....	471
Effect of sunlight on the hatching quality of eggs. F. M. FRONDA AND JULIAN A. BELO..	477
Abstract of "A study of the cost of production and distribution of income of tobacco in Ilagan, Isabela." FRANCISCO M. SACAY.....	495
That crop surplus: How chemistry is helping to solve the problem. C. MORAN (<i>Capper's Farmer</i> (Kansas)).....	497
Extension division notes.....	501
Exchange notes from— <i>Journal of Agriculture</i> (Victoria, Australia), <i>The Planter</i> (F. M. S.), <i>American Swineherd</i> (Chicago, Illinois), <i>Agricultural Journal</i> (Queensland), <i>Journal Agricultural Society</i> (Jamaica), <i>Journal of Agriculture</i> (New Zealand).....	507
College and alumni notes.....	509

NUMBER 9, FEBRUARY, 1928

The nation and science. HERBERT HOOVER (Extract from article in <i>Sigma Xi Quarterly</i> , March, 1927).....	511
The anti-beriberi vitamin content of sweet potato leaves and shoots. F. O. SANTOS AND E. G. COLLADO.....	513
The germicidal properties of the mixture of kerosene and coconut oil. ZACARIAS DE JESUS	521
Is there a solution? PABLO N. MARRUN.....	535
A study of (P. B. 119 × C. A. C. 87) F ₁ hybrid and other sugar cane seedlings and their parents. EUFRAIN M. MORALES.....	543
Note: Great Farmers. A. E. WINSHIP. <i>Successful Farming</i> (Iowa).....	557
Extension division notes.....	560
Exchange notes from— <i>Capper's Farmer</i> (Kansas), <i>Journal of Agriculture</i> (Victoria), <i>The Agricultural Gazette</i> (New South Wales), <i>Cultivator</i> (California), <i>The Prairie Farmer</i> (Illinois), <i>Experiment Station Record</i> (U. S. Dept. Agric.).....	564
College and alumni notes.....	566

NUMBER 10, MARCH, 1928

What advice shall we give to our graduates? THOMAS TAVERNETTI (<i>Quarterly of Alpha Zeta</i>).....	569
Does an agricultural college education unfit a man for farming.....	569
Cattle raising under Philippine conditions. VALENTE VILLEGAS.....	571
The seed and oil of <i>Jatropha curcas</i> . FLORENCIO A. SOLIVEN.....	587
Growth and development of young rice plants as influenced by the food in the seed. R. B. ESPINO.....	597
American and foreign capital acquisitions of the Philippine public domain. JOSÉ E. VELMONTE.....	603
Published contributions of the College of Agriculture: V. B. M. GONZALEZ.....	617
A review of "The home garden handbook on Gladiolus." VICENTE M. DAWIS.....	625
Note: The Andelros Club. NICOLAS GALVEZ.....	625
Extension division notes.....	626
Exchange notes from— <i>Quarterly Alpha Zeta</i> , <i>Agricultural Journal</i> (Queensland), <i>Gardener's Chronicle</i> (New York), <i>Journal of Agriculture</i> (New Zealand).....	629
College and alumni notes.....	631

SPECIAL NUMBER

Pages 1-83

(Not indexed)

IN MEMORIAM, CHARLES FULLER BAKER, DEAN, COLLEGE OF AGRICULTURE, UNIVERSITY OF THE PHILIPPINES FROM 1917 TO 1927:

The Funeral Addresses:	15
CHARLES W. HAMILTON.....	15
ORWYN E. COOK.....	17
The Memorial Services, Tributes by	
MANUEL L. ROXAS.....	21
MARCELO B. PEÑA.....	23
HAROLD CUZNER.....	24
GREGORIO SAN AGUSTIN.....	26
LUDOVICO HIDROSOLLO.....	27
JORGE BOCOBO.....	28
B. M. GONZALEZ.....	30
Resolutions:	
By the Council of the University of the Philippines.....	33
By the Faculty of the College of Agriculture.....	33
By the Los Baños Biological Club.....	34
By a Group of College of Agriculture Graduates at Cebu.....	34
By a Group of College of Agriculture Graduates at La Carlota, Occidental Negros...	35
Contributions:	
Charles Fuller Baker. EDWIN BINGHAM COPELAND.....	8
Charles Fuller Baker. A biographical note. ROBERT L. PENDLETON.....	13
The Charles Fuller Baker Collection. R. A. CUSHMAN.....	39
Charles Fuller Baker. A man of achievement. L. O. HOWARD.....	43
Baker and I. INOKICHI KUWANA.....	46
Charles Fuller Baker, maker of men. D. L. CRAWFORD.....	47
Charles Fuller Baker, as a fellow worker. ARTHUR F. FISCHER.....	48
Dean Baker's endeavors to advance science through welcoming visiting scientists for work at the College of Agriculture. WILLIAM H. WESTON, JR.....	49
Baker, the inspirer of youth. LEON L. GARDNER.....	53
Dean Baker in his relation to the press. ROY C. BENNETT.....	56
Tribute. J. E. HIGGINS.....	57
Dean Baker: an appreciation. IANG CHANDRASTITYA.....	61
"He is gentle that doth gentle deeds". M. B. RAYMUNDO.....	62
Our friend. EMMA S. YULE.....	80
Letters from	
GOVERNOR GENERAL WOOD.....	6
F. S. EARLE.....	47
EVETT D. HESTER.....	57
Extracts from personal letters:	
JAMES A. BLAISDELL.....	67
PAUL SERRE.....	67
OTTO A. REINKING.....	68
F. W. FOXWORTHY.....	68
D. A. HERBERT.....	68
T. V. RAMAKRISHNA AYYAR AND V. MUTHUSAMI ARVER.....	69
C. E. PEMBERTON.....	70
R. C. MCGREGOR.....	71
VINNIE REAM ABORN (Mrs.).....	71
Editorials from the Local Press:	
Charles Fuller Baker— <i>The Philippine Collegian</i>	77
Monument to Dean Baker— <i>Manila Daily Bulletin</i>	78
Dean Baker turns in his thesis— <i>The American Chamber of Commerce Journal</i> (Manila).	79

THE DEAN REPLIES¹

Every year sees some one "busting into public print" (I believe that is the proper expression) with a tirade against the College of Agriculture and its graduates. It seems to make acceptable copy when other subjects have been worn out, and it has the advantage of being a topic which apparently needs no study, it being the usual thing to merely echo previous groundless pronouncements. We have really grown quite accustomed to being held up as a "horrid example" and certainly hope that it does somebody or something, some constructive good. This time it is Mr. Pedro de la Llana who in the *Manila Daily Bulletin*, dated March 28, 1927, says:

The same thing happens with the graduates of the College of Agriculture. Here is a center of learning where the students are taught the principles of scientific farming. They spend three or four years of collegiate work, burning midnight oil in their endeavor to absorb all the knowledge needed for the increase of production. Thousands of pesos are spent by the Philippine government for the support of this school. Yet after the students graduate from the same, because of lack of capital, they are left helpless and have to engage in other kinds of work, generally of the white-collar variety.

We took the trouble last year to prepare a detailed report on the subsequent performance of all the graduates of this College from the beginning, bringing out facts as to the great material success of many of them, the good work they were all doing and the striking fact that a much larger percentage of them were actually engaged in various phases of the agricultural development of their home country than occurs in case of any American institution of this type known to us. At that time we pointed out that we were doing it for the special benefit of writers who were prone to "go off half-cocked" on this subject, the graduates themselves not suffering from need of an apologist, being fully competent and well prepared to defend their own reputations. Naturally, Mr. De la Llana could not have seen this data (certainly never even inquired for it) or he would not have perpetrated another baseless slander of this kind. Understand us—we find only one serious flaw in our friend, Mr. Pedro de la Llana, and that is that he failed to take a course in the College of Agriculture! It might have been the saving of him.

Mr. De la Llana reminds me of that classical type of spinster who knows volumes more of how to take care of children than any mother can know! He writes with disdain of "white collar jobs" though he is in such a job himself, drawing pap from the public teat! If one has to have some money,

¹ General contribution from the College of Agriculture No. 185.

I have never seen any evidence that a "white-collar job" was a less honorable method of getting it than any other—as a temporary shift, anyway. The "white-collar jobs" need and seek men—the best available—to fill them, or there wouldn't be any such jobs. It is granted that most young Filipinos would do well to use the "white-collar jobs" only as stepping stones to constructive and productive parts in Philippines industries, and numbers of our young men have already very successfully so used them. Let Mr. De la Llana list the older "young men" with whom, unfortunately, the "white-collar job" has become a habit and like Abou Ben Adhem, lo, his name will lead all the rest! At least, to be consistent, he should introduce a bill in the Legislature, denying government jobs to any graduates of this College—and that we would applaud.

Mr. De la Llana's method of teaching certainly represents a hopeless type of pedagogy. Exciting of great enthusiasms and ambitions, and leading on to great achievement is *not* accomplished by persistent inculcation of the inferiority complex, no more in a nation or an institution than in an individual. Tell Johnny often enough that he is hopelessly "no account" and he will begin to believe it! Curiously enough, the most persistent slanderers of the rising generation in this country are *Filipinos*—judging from public utterances and literary effusions. I, an American, believe that, giving them *equal preparation* and opportunities, we shall get, *ultimately*, as good a proportion of real successes, as can be obtained from the rising generation in any country. I believe in the *coming Filipino*! I have already bet heavily—the stakes the heaviest any man can lay—on a good many of them, and even now I am winning past my most sanguine earlier expectations. Young Filipinos are *not supermen*, to become public figures, great leaders, financial giants, eminent scientists, industrial kings, within a few years after graduation—especially from a scratch start—but Time can have no richer promise in human affairs than that coming from our agricultural graduates. I believe in them thoroughly, even if Mr. De la Llana does not!

Come on, boys! You have only one *serious* shortcoming, and that is, there are not enough of you!

CHARLES FULLER BAKER,
Dean, College of Agriculture.

EDUCATION AND AGRICULTURAL PROMOTION IN JAPAN: III. RESEARCH WORK¹

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to the Third Pan-Pacific Science Congress*

GOVERNMENTAL RESEARCH INSTITUTIONS

To say that no government existing at present has a keener realization of the value of systematic research in the promotion of the well-being of the people and has translated this realization into action more effectively than Japan is, I believe, to keep well within the bounds of truth. The innate sense of order of the Japanese, and the pressure of population making demand for the most effective utilization of the country's available resources partially account for this organized interest. A paternal government that is almost patriarchal in its concern for the welfare of the people gives every encouragement to the systematic pursuit of knowledge.

The number of research institutions supported by government are varied and numerous. A simple perusal of the list may give the impression that efforts are scattered to cover the field, but a visit to the different institutions will convince the most skeptical that the substance as well as the name is there. The writer was able to visit a number of government experiment stations and he was greatly impressed with the comprehensiveness of their organization, the quality of their personnel, the excellent equipment of their laboratories, the liberal support they receive, and the high quality of the research output.

A list of the more important government research institutions follows²:

Ministry of Agriculture and Forestry:

1. Imperial Agricultural Experiment Station...Nishigahara, Tokyo.
Staff: 18 experts and 30 assistants.
2. Imperial Horticultural Experiment Station...Okitsu, Shidzuoka.
Staff: 3 experts and 8 assistants.
3. Tea Experiment Station.....Kanaya, Shidzuoka.
Staff: 3 experts and 5 assistants.
4. Forestry Experiment Station.....Shimo-Meguro, Tokyo.
Staff: 15 experts and 30 assistants.
5. Imperial Sericultural Experiment Station....Nakano, Tokyo.
Staff: 18 experts and 16 assistants.

¹ General contribution from the College of Agriculture No. 186.

² Shinjo, Shinzo, et al. 1926. Scientific Japan, past and present. ii+359 p. 47 pl.
Tokyo: Maruzen Co., Ltd.

6. Experiment Station for Ornithology and Mammology.....Renkoji, Tokyo.
Staff: 1 expert and 1 assistant.
7. Imperial Zootechnical Experiment Station...Miyako Mura, Chiba.
Staff: 10 experts and 16 assistants.
8. Veterinary Laboratory.....Nishigahara, Tokyo.
Staff: 6 experts and 32 assistants.
9. Imperial Fisheries Institute.....Yetchu Jima, Tokyo.
Staff: 15 professors, 8 assistant professors, 25 technical experts and 108 assistants.

Ministry of Commerce and Industry:

1. Imperial Geological Survey.....Kyobashi-ku, Tokyo.
Staff: 15 experts.
2. Bureau of Weights and Measures.....Tokyo.
Staff: 12 experts and 67 assistants.
3. Nitrogen Research Laboratory.....Nakameguro, Tokyo.
Staff: 10 experts and 10 assistants.
4. Imperial Fuel Research Institute.....Kawaguachi Machi, Saitama Prefecture.
Staff: 8 experts and 12 assistants.
5. Imperial Ceramic Research Laboratory....Hon-machi, Kyoto.
Staff: 2 experts and 7 assistants.
6. Mine Explosions Experiment Station.....Mitate Yama, Fukuoka.
Staff: 2 experts and 6 assistants.
7. Research Laboratory, Imperial Steel Works..Yahata, Fukuoka.
Staff: Officials of steel works.
8. Imperial Experiment Station for the Silk Industry.....Hon-machi, Yokohama.
Staff: 6 experts and 8 assistants.
9. Tokyo Imperial Industrial Laboratory.....Hatagaya, Tokyo.
Staff: 15 experts and 24 assistants.
10. Osaka Imperial Industrial Laboratory.....Ohito-cho, Osaka.

Ministry of Home Affairs:

1. Imperial Institute for Nutrition.....Kago-machi, Tokyo.
Staff: 6 experts and 11 assistants.
2. Tokyo Imperial Hygienic Laboratory.....Idzumi-cho, Tokyo.
Staff: 16 experts and 25 assistants.
3. Osaka Imperial Hygienic Laboratory.....Kyobashi 3-chome, Osaka.
Staff: 3 experts and 8 assistants.

Ministry of Finance:

1. Government Institute for Brewing.....Takinogawa, Tokyo Prefecture.
Staff: 6 experts and 8 assistants.
2. Central Research Laboratory of Monopoly Bureau.....Hiratsuka Mura, Tokyo Prefecture.
Staff: 8 experts and 17 assistants.

Ministry of Communications:

1. Electro-technical Laboratory.....Osaki-machi, Tokyo.
Staff: 29 experts and 136 assistants.

Ministry of Railways:

1. Railway Research Office.....Tokyo.
Staff: 6 experts and 50 assistants.

Ministry of War:

1. Military Land Survey Department.....Nagata-cho, Tokyo.
Staff: 30 officers and 50 engineers.
2. Military Scientific Laboratory.....Tokyo.
Staff: 28 officers, 5 engineers, and 30 assistants.

Ministry of the Navy:

1. Hydrographic Department.....Tsukiji, Tokyo.
Staff: 27 naval officers, 12 civil officials, and 58 assistants.
2. Naval Experimental and Research Establishment.....Tsukiji, Tokyo.
Staff: 95 research members.

It may be seen from the above list that practically all branches of government carry on research fundamental to their administrative and regulatory duties. While this is so, however, the experimental field is rarely, if ever, subordinated to the administrative functions of the ministry, thus freeing its personnel from possible disturbance in their work should there be an urgent call for more help in administration, as sometimes occurs in emergencies. The directors of the research stations recognize as their immediate head the minister of the department, and their position in government is co-ordinate with that of administrative heads of bureaus. Their relationship with the latter is purely co-operative, as members of the same "family". In so far as the writer was able to ascertain, this relationship was most effective and cordial.

As a rule, an institute or experiment station is a complete and independent unit by itself and carries all the necessary divisions to enable it to meet the problems on hand properly. To cite two examples: the Imperial Sericultural Experiment Station has divisions of biology, chemistry, pathology, filature, mulberry trees, and general affairs; the Imperial Agricultural Experiment Station has divisions of plant breeding and cultivation, agricultural chemistry, phytopathology, applied entomology, soils, and agricultural engineering. This arrangement appears to be extremely satisfactory. While the name of one division may be similar to that of other divisions in other stations, the work is fairly distinct and bears directly on the particular problem of that experiment station.

Some of the larger prefectures, as Hokkaido, and Formosa and Korea have their own government research institutes in agriculture and industries, independent of those of Japan proper.

In addition to the institutes named above there are four astronomical and twelve meteorological and geophysical observatories, all actively engaged in research.

PRIVATE RESEARCH INSTITUTIONS

Privately endowed research institutions in Japan are comparatively rare and do not occupy the same prominent position that they do in Eng-

land and the United States. Most of them have been established within the last decade, and their activities are restricted to limited fields. However, if we may view the recent establishment of these privately endowed institutes as an indication of a tendency, we may expect them to increase in number and to gain prominence with the years. The most prominent of these are:

1. Institute of Physical and Chemical Research...Kamifujimae-cho, Tokyo.
Staff: 343 researchers.
2. Shiomi Physical and Chemical Research Institute.....Hamadori 3-chome, Osaka.
Staff: 3 experts.
3. Saito Laboratory of Electrical Communication..Sendai.
Staff: 8 experts and 22 assistants.
4. Tokugawa Institute of Biological Research.....Koyama, Hiratsuka Mura.
Staff: 6 researchers.
5. Nawa's Entomological Laboratory.....Omiya-cho, Gifu.
Staff: 1 expert and 3 assistants.
6. Ohara Institute for Biological Research.....Kurashiki-machi, Okayama.
Staff: 7 researchers.
7. Kitasato Institute for Infectious Diseases.....Shirokane-sankocho, Tokyo.
Staff: 16 researchers and 53 assistants.
8. Takeo Institute for Tuberculosis.....Hamadori Sanchome, Osaka.
Staff: 15 researchers.
9. Institute for the Investigation of the Science of Labor.....Kurashiki-machi, Okayama.
Staff: 4 researchers.

To the above list could be added the research departments of industrial concerns, such as those of the Tokyo Electric Company, The Shibaura Engineering Works, Japan Steel Works, Asahi Glass Co., Mitsubishi Paper Mills, and a host of others. Many of these are most liberally subsidized and carry on very valuable work.

Special mention should be made of the Institute of Physical and Chemical Research³, because of its relatively large endowment and personnel, its program of work, and its unique method of financing its future. It has an endowment of Yen 6,228,700, 1,000,000 of which was an Imperial Gift, 2,000,000 a government subsidy, and the rest, or 3,228,700 was contributed from official sources and from individuals. The institute concerns itself primarily with investigations in the pure sciences of physics and chemistry with a view to developing new applications.

³ Guide to the Institute of Physical and Chemical Research, Tokyo, 1926. Published by the Institute.

Once a problem is completed in the laboratory it is tested for its industrial applicability. If this is satisfactory, the rights or patents are let out to a manufacturing concern for exploitation under suitable financial arrangements, and any returns are partly used for financing the pure science work of the Institute and partly given as a reward to the inventor or discoverer. The Institute was established in March, 1917, and on May, 1926 it possessed 103 items of domestic patent rights and 21 items of foreign patent rights. Its income in 1926 from factories using its inventions and from royalties for the use of its patent rights amounted to Yen 496,000.

THE IMPERIAL UNIVERSITIES

A description of research institutions in Japan would be incomplete without special mention of the Imperial Universities. These are really the mother institutions from which all others derive not only their personnel but also inspiration. They have set such high standards that their work commands confidence and respect throughout Japan. It is rare to find a prominent scientist who is not or was not at one time or another connected with some one of the Imperial Universities. There are five of these; they are located in Tokyo, Kyoto, Sapporo, Sendai, and Fukuoka and are so situated that each serves a particular section of the Empire. Two other Imperial Universities, one in Korea and the other in Formosa, are in their formative stage.

In the organization of the Imperial Universities it is specifically provided that they prosecute original research "in such sciences as are required for the purposes of the State." This function is only secondary to teaching. In the creation of chairs in the natural sciences, therefore, the objective is not lost sight of and a financial provision is attached to it. This amounts to about Yen 3,000 for professors and half this amount for assistant professors. A more or less complete freedom is allowed the incumbent in the use of this allotment. Thanks to this wise provision, research is properly stimulated. This arrangement gives little room for evasion of responsibility, or for alibis in case of inactivity, and forthwith demonstrates the fitness of the incumbent for the work on hand. How much wiser this system is than the one generally followed of providing salaries for workers and no means or materials for them to work with, thus making their employment in the first place utterly superfluous, needs only to be considered to be realized. Most university departments function as independent institutes for all practical purposes and are so equipped as to be able to attack problems with which they are concerned from all possible angles without the need of enlisting the co-operation of other departments.

The thirst for higher education in Japan has created an army of well-qualified aspirants to university positions. Competition is, therefore, very keen and only the best reach the goal. The personnel of the Imperial Universities, in so far as one may be permitted to pass judgment, is unusually

competent, especially so in the case of the younger members who have had to meet an even more strenuous competition than their elders did.

LEARNED SOCIETIES

There are two very important learned societies in Japan, honorary in nature, as distinct from a host of societies composed of specialists in practically every recognized branch of human learning. These numerous societies are similar in nature to professional societies found elsewhere and no further mention will be made of them. The honorary societies referred to are the Imperial Academy and the National Research Council.

The Imperial Academy⁴, established in 1879, corresponds to the Royal Society of Great Britain and the Académie Française. Its membership is limited to 100 and they are appointed by the Emperor from among the most reputed intellectuals of the Empire. It is divided into two sections: literature and social affairs and science. The membership is evenly divided between the two sections. The Academy receives financial aid from the government, but the greater part of its income is derived from private donations. Its objective is to stimulate culture through honorary recognition. It publishes its proceedings in Japanese, German, English, and French.

The National Research Council of Japan, like many other research councils, is a product of the World War. It was organized in 1919 by the Minister of Education⁵. It acts as an advisory body to the government on scientific matters and their application. Its existence has been continued as a permanent organization even after the War and is now affiliated with the International Scientific Research Council. The membership is limited to 100 and members are appointed by the Ministry of Education upon recommendation of the Council. The Council is divided into research departments and the members are attached to one or more departments, depending on their specialties. The departments recognized are astronomy, geodesy, chemistry, physics, geology, and geography, biology and agriculture, medicine, engineering, and mathematics. Each department publishes one or more journals.

It is needless to say that membership in either of these societies is a signal honor conferred on the holder. Members of the Academy over 60 years old receive an annuity.

⁴ Takenobu, Y. The Japan Year Book, 1926. Year Book Office, Tokyo.

⁵ *Vide* Japan Year Book, 1926.

LOWERING COST OF RICE PRODUCTION¹

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Rice growing in the Philippines is an important problem among the farmers. In various surveys made on the cost of production of this crop, it was found that the cost was greater than the market value. Among the principal items which are responsible for this high cost of production are planting, weeding, harvesting, and threshing—all of which are done by hand.

In the Philippines there are two methods of growing rice; namely, the lowland and the upland. The lowland method, though it is the more tedious and harder on health of workers, is generally practiced throughout the Philippines. In fact, the bulk of the rice commercially grown in the Philippines is raised by this method. Several changes have been introduced to improve the lowland method but these have generally failed to accomplish their purpose. Machinery cannot be used in the preparation of the land or mucking, in transplanting the seedlings, or in harvesting. The reasons for this are obvious. In the first place, the space in which to work a machine is limited by the dikes, which enclose on the average an area of about 1000 square meters. In the second place, weather conditions are rather uncertain so that the use of machinery would not be economical, especially during the rainy season.

The method used in California can be used under Philippine conditions provided there is irrigation so that planting can be done during the dry season. Two objections are raised, however, to this method; one is that most of our short season varieties of rice are, as a rule, low yielders; the other is that the dry season is not long enough to warrant the use of this method. It is believed that these objections can be overcome by practicing seed selection and quick preparation of the land. In seed selection, erect and early maturing varieties of rice should be used so that the machines may function efficiently. The entire work would involve only from four to five months from preparation of the land to the harvesting of the crop.

The upland method of cultivating rice is believed to offer the greatest possibilities for effective lowering of cost of production. Machines can be used in this method because in most regions of the Philippines there are two dry seasons, a short one lasting from 15 to 20 days or a month and a long one lasting from four to five months. If rice is planted so as to mature in either one of these dry seasons it can be harvested safely, because all the operations

¹ Experiment Station contribution No. 443. Received for publication January 24, 1927.

would be carried out when the soil is dry. In upland fields there are no barriers to operation of machines.

This upland method has been given a trial at the College of Agriculture Experiment Station and found to be very economical. The cost of production has been reduced to not more than a peso a cavan (\$.50 a sack of 75 liters). This cost does not include the handling of rice after it leaves the field.

The saving, for the most part, is in the operations of preparation of land, seeding, weeding, and harvesting.

Preparation of the land. The land was plowed just after the last crop was harvested or before the ground became hard. A tractor-drawn disc plow was used to a depth of not less than 15.24 centimeters. This was done to bury the seeds of the weeds that were scattered on the surface of the ground. The harrowing was with a disc harrow with a drag behind it in order to smooth the field as much as possible. The field was left in this condition until the weeds germinated after the first rain in May. As soon as the weeds attained the height of about 5 to 8 centimeters, the disc harrow with the spike tooth harrow behind it was run over the fields both lengthwise and crosswise, thus destroying practically all the weeds. The depth of the cut made by the disc harrow on this mellow soil ranged from 7.64 to 10.16 centimeters, thus giving a good rice seed bed in which the young rice can grow lustily.

Seeding. The seeder that was used in this work was a La Crosse tractor drawn drill with 18 rows. The rows were set at about 17.8 centimeters apart and the seed used was about 90 liters to the hectare. The depth of planting was about 5.08 centimeters. This depth was required so that the seeds would be deposited in the moist layer of the soil.

Weeding. As the College has no weeder, regular Calamba and Batangueño cultivators were used. These implements were altered in such a way that only three shovels were used. The shovels were made to run in a straight line instead of in its usual triangular arrangement. The reason for this arrangement was to have the soil which was pushed aside by the shovels meet at the base of the seedlings, thus forming a ridge. If the shovels were not arranged in this way the tendency would be to ridge one side of the hill at a time, thus when the hilling was completed by the next shovel some of the bent plants from the first shovel would be covered.

These cultivators were drawn by one bullock which was made to walk in the furrow space thus straddling a row. The number of cultivations depended upon the condition of the field. In general, four cultivations were considered enough. The last hilling was done when the rice was about 15 centimeters tall. After the last cultivation the rice was left untouched until harvest.

When weeding is done by hand using the hand trowel (*dulus*) the average number of laborers to weed a hectare is fifty, while with animal and cultivator one man can cultivate a hectare in one day.

Harvesting. One of the difficult operations in producing upland rice is the harvesting, as the crop must be harvested and threshed within a very limited time. The harvesting must be done at a time when there is sunshine and during the rainy season sunny days are very few and often very short. For this reason, a quick method must be used. A rice binder, such as is employed in California and other rice growing regions in the United States, will serve the purpose. The binder that was used in connection with this work was a Deering rice binder, manufactured by the International Harvester Company. It gave very satisfactory results. When it is pulled by three bullocks and operated by a man using it for the first time, it can cut an average of one hectare in a period of six hours and ten minutes. This average was taken from a six-hectare lot. The machine is followed by two gleaners. The rate can be greatly increased by using a faster power to pull the machine and with a wider cut, or swath. At the rate of six hours and ten minutes to the hectare it was found to be equivalent to fifty persons, and the grain wasted during the operation is less than when harvesting is done by hand.

In threshing, the rice must be dry so that the threshing machine functions well. If the cutting of rice is done on a sunny day and the bundles are piled before the rain falls on them, and threshed when weather permits, good results will be obtained. But once the rain wets the bundles, the threshing will be very difficult. A good method is to follow the binder with immediate threshing thus threshing the grain on the same day it is cut. The threshed rice is spread thinly on the wooden floor of a shed so as to prevent heating, and dried as soon as weather permits.

GROWING PEANUTS FROM CUTTINGS¹

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WITH TWO TEXT FIGURES AND ONE PLATE

Peanut (*Arachis hypogaea*), in the Philippines, is raised exclusively from seed. As the peanut seed contains a comparatively high percentage of oil, running from 40 to 55 per cent, it is very difficult to preserve its vitality in this tropical country. For this reason, the keeping of the peanut seed becomes an important item in peanut growing, as the extent of the culture of the crop depends upon the supply of good seed for planting.

The peanut seed is large, requiring about 855 seeds of the large-seeded varieties, and about 1530 of the small-seeded ones to make a liter. With the native method of planting it requires about one and one-half to three and one-half cavans (112.5 to 262.5 liters) of peanuts to plant a hectare. This is a considerable amount.

The use of peanut cuttings for planting might help solve the seed problem in connection with peanut cultivation, as the preserving of seed and its high cost would be eliminated. Believing that a study of the production of peanut from cuttings would be of practical value to the farmer, and, perhaps, to the plant breeder, in the maintenance of a superior pure strain, an experiment was carried out with the object of finding out the yielding power of peanut cuttings. The experiment was conducted in the Philippine College of Agriculture. A preliminary study was made during the College year of 1925-26. The experiment reported herein was started in July 22, 1926 and closed on November 18, 1926.

So far as the writer knows, no previous study on the production of peanut from cuttings has been made in the Philippines. The only study on this subject that he found is that reported by Guerrero (1923) of Guam². In this study a test was made between sexual and vegetative methods of propagating peanuts. The report states that "no apparent differences were observed in the manner of growth of vine produced from seed and those from cuttings." The native variety used produced more pods and vines from cuttings, while the Chinese varieties propagated from seed gave higher yields of pods and vines.

¹ Experiment Station contribution No. 444. Received for publication, January 10, 1927. Read before the Los Baños Biological Club, December 16, 1926.

² Guerrero, Joaquin. 1923. Report of the assistant in agronomy and horticulture. Report of the Guam Agricultural Experiment Station, 1921: 8-26.

MATERIALS AND METHODS

In this experiment three varieties of peanut were used; namely, Kinorales, Lemery, and Valencia. All of these varieties belong to the bushy type.

Cuttings from peanut plants forty-three days old were prepared as illustrated in figure 1. Only the tops were used, and the cuttings were about 15 centimeters long. The cuttings were prepared and planted in the same afternoon. They were planted in furrows in a vertical position and covered with soil to almost the tip. Side by side with the cuttings, seeds of the varieties used were planted to serve as check.

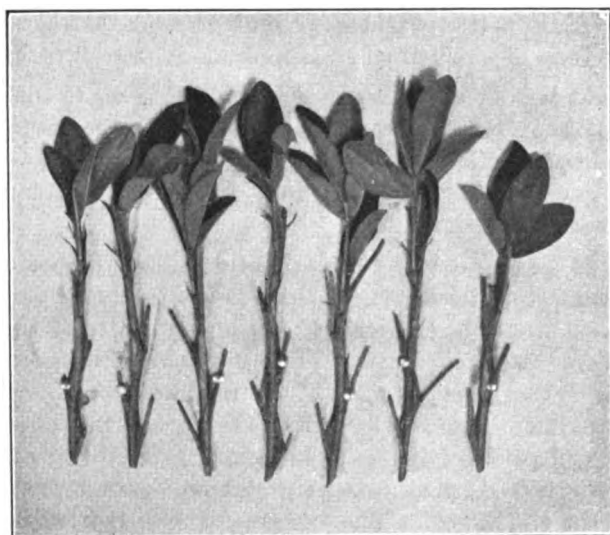


Fig. 1.—Peanut cuttings prepared for planting.

About a month after planting, the plants were thinned out so that the ones left were 30 centimeters apart in the rows. The plants were cultivated three times, the soil being thrown towards the plants in the last cultivation to form ridges along the rows of the plants. The ground was kept well weeded.

EXPERIMENTS AND RESULTS

Before the plants were thinned out, the percentage of germination of the peanut seed and the percentage of rooting of the peanut cuttings were determined. Table 1 presents the results.

TABLE 1

Showing the percentage of germination of peanut seed and of rooting of peanut seedlings

VARIETY NAME	SEED			CUTTING		
	Planted	Germinated		Planted	Rooted	
	number	number	per cent	number	number	per cent
Kinorales.....	67	65	97.01	67	67	100.00
Lemery.....	61	55	90.16	61	50	81.97
Valencia.....	70	68	97.14	70	61	87.14
Average.....			94.77			89.70

The plants from both seed and cuttings grew normally to maturity. The three varieties used matured at practically the same time. They were all harvested on November 18, 1926. The plants were carefully dug up and washed so as to remove any soil adhering to the roots and pods. After two days drying, the number of developed and undeveloped pods and the stipes without pods of the individual plants produced from each of the two kinds of propagating materials were counted. Also, the weight of the pods and of the straw of each plant was found separately.

Table 2 gives the average number of developed and undeveloped pods and the stipes without pods from the plants from seed and cuttings.

Table 3 gives the average yield of straw and table 4 the average yield of pods of the same plants.

TABLE 2

Showing the average production of pods and stipes per plant of peanuts from seed and from cuttings

VARIETY NAME	PROPAGATING MATERIALS	NUMBER OF:		
		Developed pods	Undeveloped pods	Stipes without pods
Kinorales.....	seed	26.10 ± 1.15	11.90 ± 0.67	20.40 ± 1.51
Kinorales.....	cutting	23.30 ± 0.89	13.90 ± 0.64	33.10 ± 2.04
Lemery.....	seed	19.20 ± 1.21	10.70 ± 0.92	15.00 ± 2.11
Lemery.....	cutting	18.00 ± 0.96	8.60 ± 0.70	27.00 ± 2.32
Valencia.....	seed	23.40 ± 0.94	13.90 ± 0.99	18.30 ± 0.94
Valencia.....	cutting	14.40 ± 0.73	10.10 ± 0.74	13.70 ± 0.87

TABLE 3

Showing the average production of straw per plant of plants from seed and from cuttings

VARIETY NAME	PLANTS FROM SEED	PLANTS FROM CUTTINGS	DIFFERENCE
	grams	grams	grams
Kinorales.....	46.30 ± 2.80	50.70 ± 1.82	4.40 ± 3.34 (insignificant)
Lemery.....	71.30 ± 5.71	57.00 ± 3.52	14.30 ± 6.71 (insignificant)
Valencia.....	80.80 ± 5.61	62.70 ± 2.53	18.10 ± 6.15 (insignificant)

TABLE 4

Showing the average production of pods per plant of plants from seed and from cuttings

VARIETY NAME	PLANTS FROM SEED	PLANTS FROM CUTTINGS	DIFFERENCE
	<i>grams</i>	<i>grams</i>	<i>grams</i>
Kinorales.....	39.00 ± 2.01	38.70 ± 1.30	0.30 ± 2.39 (insignificant)
Lemery.....	29.70 ± 1.77	28.90 ± 1.58	0.80 ± 1.58 (insignificant)
Valencia.....	40.90 ± 1.68	25.30 ± 1.39	15.60 ± 2.18 (significant)

DISCUSSION OF RESULTS

The cuttings of the three varieties of peanut used produced plants that matured normally. The plants from cuttings, however, recovered rather slowly at the start, but when they had fully recovered, they grew vigorously

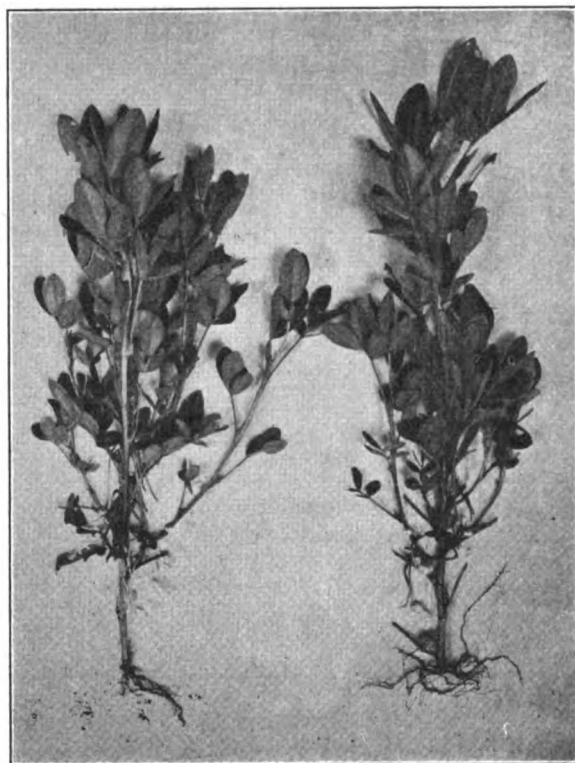


Fig. 2.—One and one-half months old peanut plants from cuttings.

and overtook the plants from seed. Both the plants from seed and those from cuttings flowered at practically the same time. At this stage it was hard to distinguish the plants from seed from those from cuttings. No

apparent differences as to the mode of growth and the production of vines were noted in the plants propagated sexually and those propagated asexually.

From the results of this short piece of work, it can be stated that some varieties of peanut can be propagated asexually rather easily. The percentage of rooting was comparatively high, ranging from 81.96 per cent for variety Lemery to 100 per cent for variety Kinorales (see table 1). The average percentage of rooting of the cuttings from the three varieties used was 89.69, while the average germination of the seeds of the same varieties was 94.75 per cent.

It is interesting to note that the peanut cuttings produced their roots only at the cut (see figure 2 and *a* in figures 1 and 2, plate I). As was expected, no roots developed from the nodes nor from any other portion of the plant. It is therefore very essential that the cut should be smooth and clean so as to hasten callousing; this may lead to higher percentage of rooting. It is apparent that the plants from cuttings had less developed root systems than those from seeds.

In table 2 is presented the average number of developed pods, undeveloped pods, and stipes without pods to the plant, of the plants from seed and those from cuttings. It is shown that in all the three varieties used, the plants from seed, except in the case of variety Kinorales, produced more pods both developed and undeveloped than the plants from cuttings. With variety Kinorales, the plants from cuttings produced more undeveloped pods than the plants from seeds. On the other hand, the plants from cuttings, except variety Valencia, produced a greater number of stipes without pods than the plants from seed. The presence of numerous non-bearing stipes is shown in *a*, figure 1, plate I. Many of the stipes of the asexually propagated plants of Kinorales and Lemery were not able to produce pods, owing, perhaps, to their inability to reach the ground. Planting the cuttings in deep furrows and covering them during the last cultivation may enable the non-bearing stipes to produce pods.

The plants from seed, with the exception of Kinorales, actually produced more straw to the plant than the plants from cuttings (see table 3). But according to the usual way of interpretation of experimental results, the differences in yields of straw as shown in table 3 are not significant. In other words, peanut cuttings of the three varieties used are as good as seed for forage and hay purposes. Besides, the relative low cost of cuttings as propagating material may justify their use.

As shown in table 4, the plants from seed in all the varieties used produced more pods as expressed in grams than those from cuttings. The three varieties, however, varied in their production of pods. In the case of variety Valencia, the average yield of pods per plant of the plants from seed was 40.90 ± 1.68 grams, while those from cuttings gave an average of 25.30 ± 1.39 grams, giving a significant difference in favor of the plants from seed. With Kinorales and Lemery, although the plants from seed produced a few more

Pods, the differences were insignificant. That is, the plants from seeds and those from cuttings of varieties Kinorales and Lemery had practically the same yielding power. Kinorales plants from seed produced 39.00 ± 2.01 grams of pods per plant, while the plants from cuttings gave an average of 38.70 ± 1.30 grams of pods per plant. Lemery plants from seed gave 29.70 ± 1.77 grams of pods per plant on the average, while those from cuttings gave 28.90 ± 1.58 grams.

This result is very significant. It shows that there are varieties of peanut that could be propagated asexually for commercial plantings in the Philippines, as Guerrero (1923) found to be true in Guam. The result further suggests a possible practical solution of doing away with the difficult problem of preserving peanut seed. Besides, by resorting to asexual propagation of peanut, the item of expense for seed could be lessened. Peanut seed which brings a good price could be sold instead of planted.

SUMMARY OF CONCLUSIONS

The limited data herein reported seem to justify the following conclusions:

1. Peanut can be propagated asexually under Philippine conditions with comparatively high success. The percentage of rooting of cuttings from plants forty-three days old varied from 81.97 per cent for Lemery to 100 per cent for Kinorales.
2. In general, the plants from cuttings produced about as much as the plants from seed. Of the three varieties used, the plants from seed and those from cuttings of Kinorales and Lemery had practically the same yielding power of pods. Valencia plants from seed, however, were decidedly better than those from cuttings.
3. The differences of the straw production of the two kinds of propagating material in the three varieties used were insignificant. However, the plants from cuttings of Valencia and Lemery had the tendency to produce more straw than the plants from seed.
4. While, in general, the plants from seed produced a slightly greater number of pods, both developed and undeveloped, than the plants from cuttings, these produced more stipes without pods. The potential pod producing power of the two kinds of propagating material were practically the same.

The results herein reported undoubtedly open up a new field of research for the amelioration and increase of the peanut industry. A more thorough study of the use of peanut cuttings of different kinds for field planting, and the best season of the year for planting, would certainly give results that would be of practical value.

ILLUSTRATIONS

PLATE I

- Figure 1. Matured Valencia peanut plants. (a) Peanut plant from cutting. (b) Peanut plant from seed.
- Figure 2. Matured Kinorales peanut plants. (a) Peanut plant from cutting. (b) Peanut plant from seed.

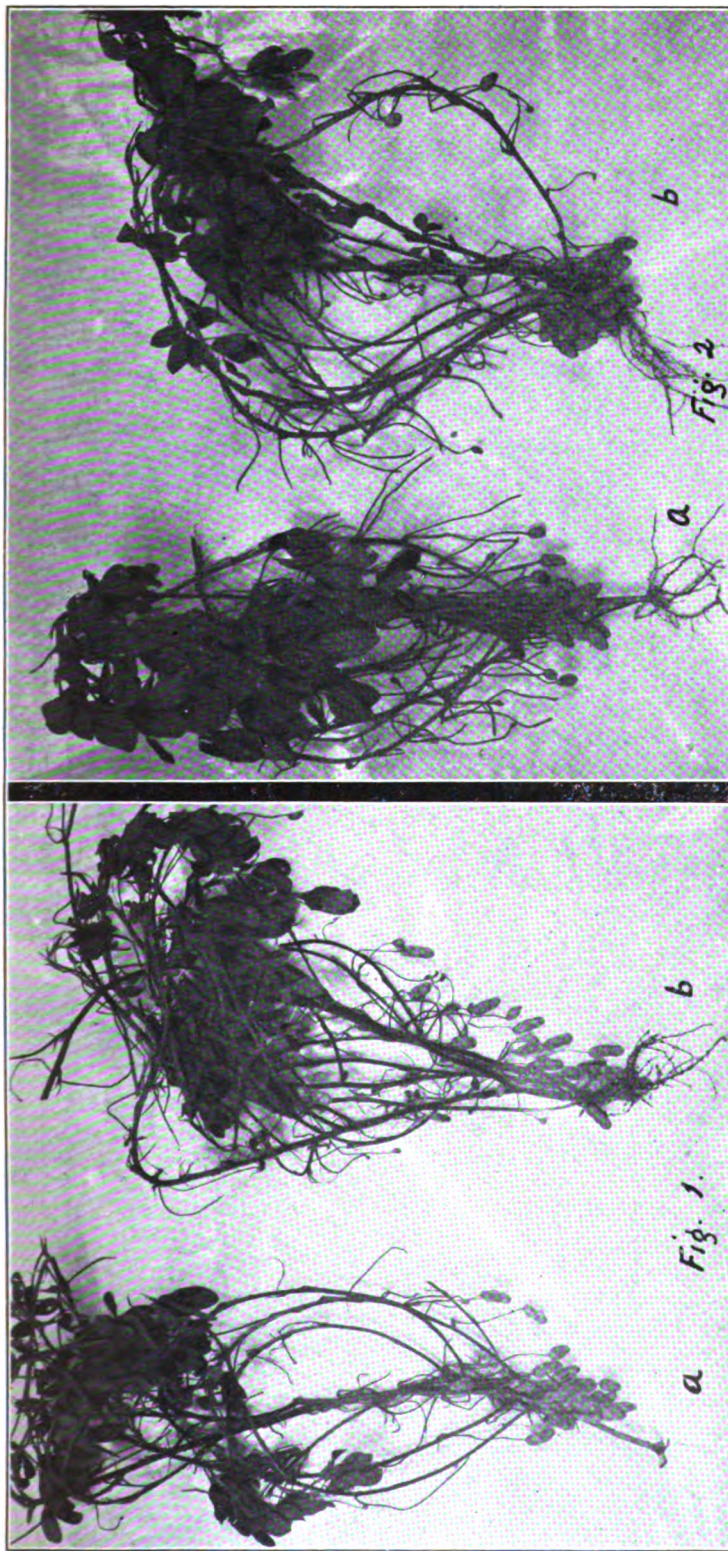


PLATE I

STUDY OF THE TOBACCO GROWERS' ASSOCIATION INC. OF TUGUEGARAO, CAGAYAN¹

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Of the Department of Rural Economics

PURPOSE OF THE STUDY

This study of the Tobacco Growers' Association Inc. of Tuguegarao, Cagayan, was conducted during December, 1925 and April and May, 1926. It involved an analysis of the organization, its operations, membership relations, comparison of selling prices of tobacco obtained by members of the association with those received by non-members, its selling program, and other points of interest.

The main purpose of the study was to give to students in the course on Rural Co-operation and Credit given in our department the opportunity to get first hand information about the practical application of the fundamental principles of co-operation as applied to farmers' business. It was believed also that the data obtained might be helpful to other associations that may be organized, as this association is the first of its kind in the Islands, except the one established in Ilagan, Isabela, by the same man who organized the Tuguegarao association.

In conducting this study the writer interviewed the agents of the government promotion work, such as the Agent of the Bureau of Commerce and Industry who is the organizer and adviser of the association, the Farm Adviser of the province and some local government officials; and several members of the association in the different barrios of the municipality of Tuguegarao, local agents, called *almaceneros*, of the companies buying tobacco in the Cagayan Valley and some politicians interested in tobacco business. In addition to these interviews, the writer used as references the Report of the Survey Committee that investigated the tobacco industry in the Cagayan Valley in April and May, 1926 and Circular No. 397 of the United States Department of Agriculture entitled *Farmers' Co-operative Business Study* and some other works on tobacco.

FEATURES OF THE ASSOCIATION

Through their collective sale of their tobacco of the 1925 crop the members of the association showed to the tobacco growers of Cagayan that their crop could be sold through co-operation for prices adjusted to the quality of product. Before the organization of this association, the local

¹ Experiment Station contribution No. 445. Received for publication March 11, 1927.

buying companies or individual buyers in the locality fixed the prices for the tobacco of the farmers regardless of quality. Tobacco leaf of the highest quality was bought at the same price as the lowest grade leaf—a method of buying locally known as the *uno-con-otro* method.

In so far as the product of the members is concerned the association seems to have succeeded in stopping this old practice of the local buyers. They now have to pay for the tobacco bought from the members according to the class of the leaf as classified by the farmer in accordance with instructions given by the association. The association requires its members to classify their tobacco before sale by a simple process. It consists in separating the *clases* from the *menores*. (*Clases* are the leaves suitable for cigar making and *menores* are leaves used for fillers and minor purposes.) The buyers send representatives to approve or disapprove the farmer's classification before any offer for the tobacco is made. When a disagreement arises because of this classification between the representative of the buyer and the farmer, the matter is arranged by a committee of arbitration composed of a representative of the buying company and a representative of the association. If this committee decides that the classification is not satisfactory, adjustment is made to conform with this decision.

The association accumulates funds from commissions it receives from buying companies. These commissions depend upon the quantity of the tobacco sold. They range from fifty centavos to one peso per 100 *palillos*.

In the beginning this commission constituted the only income of the association. The fund enabled the association to help some of its members finance their farm operations and other needs by giving them character loans or crop loans, and to pay for the services of some of its officers.

The other important feature of the activities of the association was the establishment of a line of stores for merchandise where the members and the general public could buy their staple necessities. At the time this study was begun in December, 1925, the first store of the association was operating in the barrio of Annafunan.

THE ORGANIZATION OF THE ASSOCIATION

The Tobacco Growers' Association Inc. of Tuguegarao, Cagayan, was incorporated under the Bureau of Commerce and Industry in 1924. Its central office is located in the barrio of Annafunan, the largest of the thirteen barrios covered by the association in the municipality of Tuguegarao. The association is a non-stock, non-profit organization of the so-called centralized type. Its working capital comes directly from the commission it receives from sales of the tobacco crop of its members.

The association has no local units, but it functions through committees, one for each of the thirteen barrios, performing some of the functions that usually devolve upon local units.

The association has a Board of Directors consisting of nine members elected by the committees from each barrio. The members of this Board must be members of the association, except the president, who may or may not be a member and who may also be the manager of the association. Each of the members of the Board is given the power to supervise a district. He may at the same time be a member of the committee from that district. The Board elects its own president, vice-president, secretary-treasurer, and manager. The manager and the secretary-treasurer receive fixed salaries. The other members of the Board are given nominal compensation for their services.

The Board of Directors is assisted by a committee which acts as an advisory body to the central organization. The members of this committee are elected by the members in each barrio, the number of committeemen elected from each barrio depending upon the number of members of the association in that barrio, but in no case should there be less than two members of this committee elected from any one barrio. These committeemen must be members of the association. This advisory committee confers with the Board of Directors on matters pertaining to the administration and management of the barrio organizations.

The barrio units—as they may be called for convenience, as it has been stated that the association has no local units—each has a committee whose members are elected from among the members of the association in that barrio. These committees supervise the work of the members in their respective barrios in the marketing and delivery of the tobacco to buyers. Hence, the members of these local committees should be farmers who are well informed about the classification of the tobacco; they are generally the more advanced and more influential members of the association in the barrios they represent.

According to the report of the Survey Party of the University of the Philippines, the association receives the advice of government agents from the Bureaus of Commerce and Industry, Agriculture, and Internal Revenue. They form the Advisory Board to the Board of Directors of the Association. The Agent of the Bureau of Agriculture advises on matters pertaining to culture and curing of tobacco; of the Bureau of Internal Revenue on classification; and of the Bureau of Commerce and Industry who is *ipso facto* the technical adviser of the association, advises on matters of marketing, transportation, accounting and keeping of books. In case of difference of opinion between the Advisory Board and the Board of Directors, the matter is referred for final decision to the members in a general meeting.

The report of the Survey Party further states that there is a marketing committee composed of the manager as chairman and two other members of the association. The duties of this committee are to study the local market, to approach prospective buyers and report their findings to the Board of Directors or to the members of the association in a general meeting,

as the case may be. This committee draws up rules and regulations governing the actual marketing of tobacco, that is, the details of the negotiations, prices, etc., subject to the approval of the Board of Directors.

Membership of the association is composed of tobacco farmers from thirteen barrios of the town of Tuguegarao, Cagayan. Only two barrios did not register membership in the association. Effort was made to bring all the farmers in each barrio into the association, but there are many farmers in some of these barrios who for various reasons do not desire to become members of the association. These farmers are a constant menace to the activities of the association as they constitute a discordant element in the community toward the activities of the association. The barrios in the municipality of Tuguegarao represented in the organization are:

- | | | |
|--------------|----------------|----------------|
| 1. Annafunan | 6. Caritan | 11. Namabbalan |
| 2. Attulayan | 7. Cataggamman | 12. Pal-lua |
| 3. Bagay | 8. Larion | 13. Ugag |
| 4. Buntun | 9. Libag | |
| 5. Capatan | 10. Linao | |

The two barrios of the municipality which have not yet entered the association are Caggay and Tagga.

The central office of the association is located in the barrio of Annafunan. All business of the association is transacted at or through this central office.

The members residing in the twelve different barrios represented in the association get in touch with the central office of the organization through their respective committees.

CONTRACT BETWEEN THE ASSOCIATION AND MEMBERS

The contract is very important in a co-operative association because it binds each member to the association. It helps the members to see their duties toward their organization and the duties of the association toward them. It is, therefore, important that the terms of the contract be binding and provisions drawn defining the punishment for those who break the provisions of the contract.

Before a farmer can become a member of the Tobacco Growers' Association Inc. of Tuguegarao, Cagayan, he has to sign a contract the most important provisions of which are:

(1) That the signers of the contract are *bona fide* farmers, landowners, or leaseholders who grow or possess tobacco. As members, they agree to follow and abide by whatever rules and regulations the association may prescribe for the marketing of their products in collective and co-operative way with a view to receiving better prices for the members.

(2) The association is empowered to gather the tobacco of the members and sell it according to the classification adopted by the association. If, because of unsuitable place for storing tobacco, the association cannot assemble the holdings of its members, the members are allowed to take care of such holdings in their houses until such a time as they are sold by the association.

(3) The association promises to market the members' holdings at the highest possible prices obtainable, and to pay them the whole proceeds, said prices to be in accordance with said classification. Only such expenses as are absolutely necessary to operate the association and of handling the produce may be deducted from the proceeds of the sales.

(4) The association can sell the tobacco to any company or person offering the best terms.

(5) Any member may sell his tobacco to any tobacco buyer who offers a better price than what the association can get, provided that said member should first get the permission of the association. If the member complied with this requirement and the buyer failed to carry out the provisions of his contract with the member, the association will furnish said member with all necessary legal aid without charge.

(6) Members who violate this provision of the contract will pay a fine of ₱5.00 per quintal of tobacco which he sold without the consent of the association. This is considered as "liquidated damages." Furthermore, members agree to pay the association all its expenses and court fees should judicial proceedings be necessary.

(7) The association can co-operate or join with other similar associations in the formation of a central agency for marketing purposes, and may help in the expenses of said central agency.

—(Quoted from the report of the Tobacco Survey Party of the University of the Philippines.)

The study indicates that since the beginning of the business operations of the association there has been only one member who tried to violate article 5 of the contract. This member was lured by the unusually high price offered to him for his tobacco. Apparently he was so eager to accept the terms offered to him by the buyer that he forgot to inform the association that he was going to sell his tobacco himself. He, however, did not succeed in getting the money because the Technical Adviser of the association prevented the consummation of the sale by instituting a complaint in court. His tobacco, which was being hauled to the buyer's warehouse, was seized as a result of this complaint. A court decision was rendered in favor of the association. With this exception, there has been no attempt on the part of any member to violate the provisions of the contract.

The fact that the members abide by the terms of their contracts with the association shows their willingness to co-operate. They realize the benefits derived from co-operative effort.

MEMBERSHIP RELATIONS

Deliveries

As has been stated, the figures used in this study are those based on the result of the business operations of the association in 1925, its first year of existence. During that year, the association delivered to its buyer, the Alhambra Cigar and Cigarette Manufacturing Company, a total of 557,663

palillos of tobacco valued at ₱64,302 and distributed among the thirteen barrios represented in the entire organization as follows:

<i>Barrio</i>	<i>Amount delivered palillos</i>	<i>Value pesos</i>
Annanunan.....	171,530	19,274.80
Atulayan.....	14,198	1,570.72
Bagay.....	42,752	4,568.55
Buntun.....	13,737	1,589.86
Capatan.....	45,510	5,030.30
Caritan.....	1,550	170.00
Cataggamman.....	62,352	7,974.05
Gosi.....	1,900	237.50
Larion.....	15,600	1,997.00
Libac.....	87,480	9,996.67
Namabbalan.....	18,300	2,327.10
Pal-lua.....	65,474	7,455.20
Ugag.....	17,270	2,110.40
Total.....	557,663	64,302.15

The association realized a commission of ₱5,576.63 from the Alhambra Cigar and Cigarette Manufacturing Company for the above sale of tobacco. The total amount delivered to the company by 450 members gave an average of 1,239.25 *palillos* for each member, or an average income of ₱142.89.

The members delivered their own tobacco, individually, at their own expense, but through the association, to the Alhambra Cigar and Cigarette Manufacturing Company. The association prepared a list of the members who delivered their tobacco to the company with the corresponding amounts of the product sold by the individual members. The company made the payment direct to the treasury of the association. After the treasurer received all payments the association delivered to the members their corresponding shares of the money, or the amounts equivalent to the selling price of their tobacco.

WAREHOUSING

The association owned no warehouses at the time when this study was made, but the management was planning to erect some as soon as the association finances warrant it. The individual members kept their produce in their houses or in separate buildings built for this purpose at their own expense.

Warehousing facilities by the association were observed by the writer to be an indispensable factor for the success of the organization. The majority of the members of the association are too poor to provide a place adequate for storing their produce. Consequently, the majority of these farmers place their tobacco in the living room of their houses. If there is not enough room in the one-room bamboo house of the farmer, he places his tobacco under the house. Both of these practices are objectionable,

the first, because it is unhealthy for the farmer and his children to breathe the dust of the tobacco, and the second, because the tobacco thus kept is dirty, filthy.

Recommendation

Inasmuch as the Government is taking an interest in the improvement of the conditions of these tobacco farmers, it should provide funds for the erection of proper warehousing facilities in the tobacco region; particularly, for the use of the marketing associations already organized there. In the opinion of the writer, this is one of the best aids the Government can give to these struggling tobacco planters.

In addition to warehouses, the association should encourage its members to build community curing sheds where they can properly cure and classify their tobacco, thus insuring the turning out of better quality of finished product. This could be done by encouraging each barrio organization to build at least one curing house for the common use of its members. Funds for the expenses of erecting such curing sheds could be raised in the following manner: Charge each member a fixed sum, say ₱5, to be considered as deposit. When the curing house is finished, nominal fees should be charged every member for its use. The members will continue paying such fees for the use of the curing house until the entire amount spent for its erection is recovered. Then, when the association has collected from the members enough money from fees to cover the cost of the curing house, the deposit of ₱5 may be returned to each member. After that no more fees should be collected for the use of the curing shed. Each member could now use the curing house for curing his tobacco free of charge. Other curing sheds, as the need for them arises, could be built under a similar financing method. This would do away with the common practice of curing the tobacco under the houses or near the kitchen.

PRICE AND SALES POLICY

One of the most important problems that confronts a co-operative marketing association is the development of an effective price and sales policy. This responsibility should rest upon the board of directors. The responsibility of formulating a price and sales policy for the Tobacco Growers' Association Inc. of Tuguegarao rests mainly upon the technical adviser of the association. This apparent deviation from the common practice among co-operative marketing associations was perhaps necessary under the conditions in which the association is operating. The members of the Board of Directors of the association are farmers who have had no experience in formulating any definite program for the sales of their product. They have been accustomed to selling their tobacco at prices regardless of quality. They waited for the buyers who fixed the prices for their crop.

There are two prevailing theories as to what constitutes the best price and sales policy for a farmers' co-operative marketing association. One of

these assumes that it is the aim of a co-operative association to effect such control of a product as to enable it to dictate an arbitrary price, without reference to supply and demand conditions. The other theory assumes that an organization cannot maintain prices which are out of line with economic conditions, and that it could only make its members realize the benefits from co-operative effort by the development of a price and sales policy which attempts to adjust supply to market demand.

Apparently the Tobacco Growers' Association Inc. of Tuguegarao has attempted to carry out a price and sales policy based on the theory which assumes that it is the aim of a co-operative organization to effect such control of a product as to enable it to dictate an arbitrary price without reference to supply and demand conditions. The association tried to control the tobacco of its members, refusing to sell it to buyers when prices offered by them were the same as those offered to non-members. This method of sale was adopted by the association in order to combat the usual method of fixing prices for tobacco by the buyers. The association could not effect a policy which assumes that prices depend upon the supply and demand of the product because the scope of its activities covers only a very small portion of the entire tobacco region. Even in the same locality where the association is organized it has to compete with farmers who are not members of the organization. The association, through a vigorous campaign of its officers and advisers, was able to hold the tobacco of its members until an offer was made at prices which were the highest quoted in the province that year.

Prices

One of the objectives of a co-operative marketing association is to get the highest possible price for the product it handles, and to maintain that price once it has obtained it. In order to attain this objective, an association should establish standard grades or classification for its product and should see to it that the members raise as nearly as possible the same quality of that product. This will also necessitate the control of the flow of the same product to market,—a method of marketing known as “orderly marketing.” This method requires the holding of the product and the releasing of only that amount demanded at each time by the consumer in order to avoid the overstocking of the market with the same, and to prevent the fall of prices due to oversupply.

By holding over the tobacco of its members, the association was able to get the highest prices offered for tobacco in the province of Cagayan for the crop of 1925. The highest prices received by farmers who are not members of the association were the lowest prices offered for the tobacco of the association that year. The following table shows the prices of tobacco sold by the association according to class and prices received by farmers who

are not members of the organization: The non-members sell their tobacco by the old method, that is, with no relation of price and quality.

<i>Grades</i>	<i>Per 100 palillos</i>
Tobacco with 50 per cent clases and 50 per cent menores.....	₱ 15
Tobacco with 45 per cent clases and 55 per cent menores.....	14
Tobacco with 40 per cent clases and 60 per cent menores.....	13
Tobacco with 32 per cent clases and 68 per cent menores.....	11
Tobacco with 30 per cent clases and 70 per cent menores.....	10 to 11
Tobacco of non-members in Tuguegarao, Cagayan.....	4 to 11
Tobacco of non-members in other towns in the province.....	2.50 to 12
Tobacco in Manila market per quintal.....	₱16 (1 Quintal = 100 palillos)

It is shown by the above table that this Tobacco Growers' Association, like all other co-operative marketing associations, tries to standardize prices of its product according to its own method of classification. With the first year's experience of the members in selling their tobacco according to quality, they began to realize that better grades of tobacco bring higher prices than poorer ones and that there is a decided advantage in selling their product at prices corresponding to the different grades instead of selling the whole product regardless of its quality. According to an item published in *The Philippine Tribune* on March 23, 1927, the association received for its tobacco crop of 1926, prices ranging from ₱9.00 to ₱10.50 per quintal, whereas non-members received about ₱8.00 per quintal for tobacco of the same quality as that sold by the association.

It should be remembered that the fixing of prices is not done by the tobacco farmers but by the well organized companies buying the product. It appears, however, that the association, although still very young, has been able to influence somewhat the fixing of prices for its own product. If this association is given the proper support both by the government and the farmers its influence in the fixing of prices in the future may become wide.

Knowledge of customers

Personal acquaintanceship and contact with customers are important factors of successful merchandising. These lead the merchant to understand the needs and psychology of his customers. Knowing these, the merchant can better adjust his products to suit the demand of his customers. The Tobacco Growers' Association, through its technical adviser and the members of its marketing committee, has done a great deal toward becoming acquainted with the personnel of the companies and private persons interested in buying tobacco. It is believed that through the efforts of these officers of the organization more could be done in this direction to the end that "customer-preference", which is very essential in merchandising, may be strengthened.

Terms and method of sale

The association, through its marketing committee, looks for prospective buyers. The members of this committee go to the different buying companies and tell them about the quantity of tobacco the association is ready to sell and at the same time ask them how much they can offer and what quantity they can buy.

Upon learning that the association has tobacco to sell, these companies send out agents to see the tobacco. Then bargaining begins. The company offers to buy all the tobacco of the association; provided the prices offered by all the buyers differ but slightly, the bargain is closed. A contract is drawn between this company and the association. This contract includes the amount of tobacco bought, prices, the date and manner of delivery, reclassification of improperly classified tobacco, payment for product and commissions by the company to the association. This contract is signed before a Notary Public by the president of the association or by its technical adviser and the Representative of the company. Witnesses for both parties are also required to sign the contract.

Before the delivery of the product, the company sends out agents to approve or disapprove the classification of the tobacco by the farmers. If any classification is disapproved by these agents reclassification is immediately made to conform with the decision of the committee of arbitration as explained in the first part of this paper. When everything is settled regarding classification, deliveries begin.

The members deliver their product individually at their own expense. A careful record of the delivery by each member according to grades is made by the secretary of the association. The treasurer refers to this record when payments to members are made. During the deliveries there must be present in the warehouses of the company representatives of the association and the company to check the tobacco delivered by each member and to see that no cheating on either side takes place. After the deliveries, payment is made direct to the treasury of the association.

Then, distribution of the money to the members follow. As there are thirteen barrios composing the entire organization, it takes time to make payments to all members. The treasurer makes the payments in the following manner: A meeting of all members in one barrio is called. The treasurer distributes to the members their corresponding shares of the money. Then he goes to the other barrio and repeats this procedure until he has distributed all the proceeds of the sales to all members who sold their tobacco through the association.

Financing

The greatest handicap of the association is the absence of a bank from which the members could get loans for buying supplies while awaiting the buying season for tobacco. Tobacco is a commodity which requires a

long period of preparation after harvest. The farmers have to cure, ferment, and classify their produce before they are able to offer it for sale. This takes from two to three months. Besides, the buying season for the crop is fixed. It starts usually in July and ends about the middle of November. This means that the farmers have to wait from April to November, or seven months from the time they harvest to the end of the sales season, before they can get the money for their tobacco. While these farmers wait for the sales, they are forced to borrow money from persons who charge them usurious rates of interest. At times they cannot pay these loans in cash and instead they have to pay them in tobacco which may be many times the value of the loans.

The association has been helping its members out of this difficulty. It charges each member ₱0.20 as membership fee and ₱2.00 annually as maintainance fee. The membership fee is used for incidental expenses of the central office while the maintainance fee is used for financing a weekly published in Ibanag, the local dialect of the farmers. If there is any amount not used out of these fees after taking care of these expenses, the association uses the money for buying supplies needed by the members and selling these at cost to them. The association also encourages more well-to-do members to sell to it any surplus corn they may have. In turn, the association sells this to the needy members on credit. The cost of this corn is deducted from the money realized by these members from the sales of their tobacco.

The association being a non-stock organization raises money whenever occasion for it demands, by requiring each member to contribute a fixed sum. This is the manner by which the association raised funds for erecting the office building and buying the office equipment and supplies.

No amount is retained by the association from proceeds of sales of the tobacco of its members. The individual members take care of the expenses in marketing their tobacco and in preparing same for market. This should be the work of a co-operative marketing association in order to effect economy in marketing operations; but this association was not in a position to do this. It had not the funds necessary to finance the marketing. It could not exact from its members enough money for this purpose because the majority of them are too poor to pay a heavy contribution. The organization, however, plans to take over this work from its members as soon as its finances warrant. The members will have to wait for some years before they will be able to make use of the association in this connection.

Besides the fees collected from its members, the association accumulates money from commissions from companies buying its product and uses this fund for loans to members at nominal rates of interest.

COST OF OPERATION

The subject of costs is the thing that provokes heated discussions in a co-operative marketing association. This is because the members always

want to know where the money they contribute to the association goes, or how it is spent.

The experiences of this association along this line were not available. The association does not keep any record of expenses for marketing operations, because the individual members do not keep records of their expenses, and expenses for the marketing of their crop were borne by them individually. This method of financing the marketing operations of the association was thought to be the best plan under the existing conditions as the organization started its business operations with no funds. And it was deemed unwise to ask the members at the very start to contribute adequate cash for defraying these marketing expenses. Few had surplus money and there was the danger of arousing suspicion among the members if at the beginning the association exacted large amounts of contributions from them. They might think that the association was established only for the purpose of getting money from them without first showing them the advantages they could derive from membership in the organization.

DIFFICULTIES IN THE ACTIVITIES OF THE ASSOCIATION

As with other young organizations, the Tobacco Growers' Association of Tuguegarao, has met and is still meeting many difficulties in carrying out its activities. This study shows that the association has had to deviate from some of the well-established principles of successful co-operative marketing associations in order to meet conditions existing in the locality and to keep within the intelligence and experience of the farmers. For example, the association does not retain any of the money it receives from sales of the tobacco of its members. Co-operative associations elsewhere do, for by so doing the members feel that they are part and parcel of the organization and that it cannot function without their financial support. Also the co-operative spirit among the members is strengthened because they feel that all of them are for the association and the association is for all of the members. But the Tuguegarao association could not have this feature as yet, because of the prejudice of the members against associations of this character. They cannot readily grasp the sound motive for exacting from them certain amounts of money to support their organization. They will have to be shown material benefits derived from their connection with the association before they can be convinced of the importance of running the organization at their own expense. Again, the association does not handle the financing of the actual marketing of tobacco of its members. It leaves this work to the individual members themselves. Economies could be effected if the association took care of this work, but it could not do so because the members would not readily agree to such a proposition. They would stick to the old method of bringing their product to the buyers because they are accustomed so to do. A sudden change from this old practice would not meet the approval of the farmers. The association

has to go slow in introducing new methods or principles no matter how sound they may be into the business of these tobacco farmers.

In the beginning, the association planned to eliminate entirely the middlemen from the field of marketing. The middlemen were aware of this and they tried hard to prevent the association from carrying out its plans. They devised all kinds of ways to obstruct the progress of the business activities of the organization. When a company offered to buy the tobacco of the association, they would go out to the members and offer them prices higher than those offered by the company in order to destroy their faith in the organization. They would threaten the members telling them that the association was only a bluff and that it was organized just so that the organizers would get the benefit out of the help of the members.

Successful co-operative associations elsewhere discovered that it is impossible for them to entirely eliminate the services of the middlemen. They found that this is one of the limitations of the activities of any co-operative marketing organization. What an association could do is not to entirely eliminate the middlemen from the field of marketing but to integrate the processes of marketing—bring a succession of steps under one control. This would eliminate the services of unnecessary middlemen and would bring economies in the management. The expenses for the services of such unnecessary middlemen could be diverted to increase the profits of the farmers. Like other co-operative marketing associations, the Tobacco Growers' Association of Tuguegarao discovered the futility of trying to eliminate the middlemen from the field of tobacco marketing. When the association found that the middlemen were antagonistic toward the business progress of the organization, the Board of Directors of the association, through the advice of its technical adviser, changed its policy in dealing with these middlemen. Instead of ignoring them, the association tried to gain their support by asking them to help the organization look for buyers and thus get a share of the commission, or persuaded them not to meddle with the affairs of the association. This support was accomplished to some extent through tact on the part of the technical adviser and other officers of the organization. During the latter part of the year of 1925, the association found no difficulty in dealing with these middlemen who at the beginning of the business operations of the organization had been campaigning vigorously in order to obstruct the progress of the society.

Due to lack of men who are experienced in business, the association had to accept the election of inexperienced men to its Board of Directors. This led the association, in the beginning, to be in trouble with local politicians who are interested in the tobacco business. These politicians tried to prevent the association from getting members by discouraging farmers from joining the organization. The association should try its best to employ as manager a man who is experienced in the tobacco business even if it has to pay a high salary for the services of such a man. In the long run it

would be cheaper to hire such a man than to employ an inexperienced manager at low salary.

HOW MEMBERS HAVE BENEFITED

As has been stated, this study is based on the first year's business experience of the association. It is, therefore, not just to draw conclusions from this short experience of the organization. However, the facts and experiences of the association in its initial activities may be of some value to those who are interested in co-operation.

It took the government agent more than two years to study local conditions and come in personal contact with the farmers and become familiar with the communities before he could organize the association. At the time this attempt at co-operation was launched, prejudice was rampant throughout the valley against associations of this character because of failure of former attempts in this direction.

But some beneficial results were attained by the association. It sold the tobacco of its members at the highest prices paid for tobacco in Cagayan during the year. It was able to realize from these sales a commission of ₱5,576.63. It helped its members out of their financial difficulties by giving them loans from the money it accumulated from commission at rates of interest very much lower than those offered by any commercial banks or money lenders. It has stopped, to some extent, the practice of usurers in taking advantage of the helpless financial situation of the farmers in lending them money payable in tobacco. It has showed the services of middlemen to be superfluous and that their earnings could be diverted to increase the farmers' profits. It has helped the farmers, too, in selling them supplies at cost. It has established a weekly newspaper published in the local dialect, the aim of which is to educate the farmers on lines of rational farming and acquaint them with the activities of the organization. Above all, the association has aroused the interest of the tobacco farmers of the Cagayan Valley in co-operative movement, a thing which may lead in the future to a comprehensive co-operative organization of tobacco growing regions of the Islands, for the sole purpose of marketing this crop.

The Tobacco Growers' Association of Tuguegarao is yet in its infancy. The results obtained in this study cannot be used as a basis for judging the efficiency of the organization. If all the tobacco farmers in the Cagayan Valley could be organized into several local associations and then a federation of these associations be established, then, the tobacco farmers would be able to wield a powerful influence in the fixing of prices for this commodity, if they could not entirely control marketing prices.

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THE COST OF RAISING PULLETS UNDER CONDITIONS EXISTING IN THE COLLEGE OF AGRICULTURE¹

PEDRO S. PAJE

WITH ONE CHART

INTRODUCTION

The success of poultry farming as a business depends to a great extent upon the cost of production of the particular products. In poultry raising, if the cost of keeping poultry is analyzed it will be found that it is distributed among four principal groups. These are: (1) feed cost, (2) labor cost, (3) cash expenses, and (4) capital charges.

The cost of raising pullets is one of the largest items in poultry production, and facts about this item may answer some of the common questions of our poultrymen.

Review of literature

Resananda (1924) who worked in this College reported that the average cost of hatching Cantonese eggs was ₱0.19 per chick produced. As to the cost of raising pullets, however, no investigation has been conducted and published in this country.

Brown (1905) conducted experiments similar to this from the results of which he concluded that the average cost per bird, from egg to maturity, ranges from 15.42 cents (₱0.3084) with cross breeds; to 17.32 cents (₱0.3464) with Wyandottes. The cost of feed per pound (0.45 kgm.) of grain was practically the same for all birds, averaging around 6.6 cents (₱0.132). Withycombe (1905) reported that from 100 eggs set, 75 chickens were raised. He found also that in spite of the high cost of feed, the flock gave a profit of 180 per cent on the original investment of \$15.00 (₱30.00). His conclusion was that a small flock of poultry may be profitably kept under confinement, and that early hatched pullets are more profitable than those from late hatches. Graham (1909) reported that with chicks hatched in May and September, raised in a pasture, 345 consumed 4,304 pounds (1,956.4 kgm.) of grain. The cockerels were removed when they weighed about 3½ pounds (1.59 kgm.) each, and the breeding stock was taken from the pasture in October. On the other hand, 773 chicks hatched at

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different times and raised in an orchard consumed 8,649 pounds (3,926.8 kgm.) of grain. He further reported that it costs from five to seven cents (₱0.10—₱0.14) to hatch the chicks. Philips(1916) found that the cost of a White Leghorn pullet up to the time of laying varied largely with feed prices. The average cost of raising White Leghorn pullets was 43.4 cents (₱0.868). When the profit from the cockerels was credited, the net cost of the pullets varied from 24.3 cents (₱0.486) to 50.5 cents (₱1.01), the average being 38.1 cents (₱0.762). In these experiments he found also that 457 eggs were necessary to raise 100 pullets. Another investigator, (Anonymous, 1914) reported on chicks for the early part of the growing period and found that this is the most expensive period of production. The cost of feeds during this period exceeded one-half the lowest market price which was usually 16 cents (₱0.32) per pound (0.45 kgm.) live weight for prime young stock. Gray (1916) in a similar experiment found that with mixed breeds, it cost slightly over 8 cents (₱0.16) to produce profits. Still another investigator (Anonymous, 1915) stated that the feed cost was less when the chicks were hatched and reared artificially than when hatched naturally, as in the latter case, cost of feeding the mother hen was charged against the chicks.

Objects of the experiment

The main object of the present experiment was to determine the cost of raising Cantonese pullets under conditions existing in the College of Agriculture. The secondary objects were: (a) to find the amount of feed consumed at different ages under a liberal feeding system, and (b) to find whether or not poultry raising under these conditions is profitable.

Time and place

The experiment was conducted in the Poultry Division, Department of Animal Husbandry, College of Agriculture, Los Baños. The first part of the experiment was from December 15, 1924 to October 15, 1925. The second part was carried on from December 15, 1925 to October 11, 1926.

MATERIALS

As recommended by Leoncio (1924) only eggs which were not more than ten days old were used in this experiment. Cantonese eggs were used. Incubators, brooders, a nipa poultry house, and yards were used in the raising of the chicks. Feeds and other equipment including those already mentioned were all supplied by the Department.

The feeds given to the birds were grain, mash, eggs, and common salt. Besides these feeds they had plenty of green grass at their disposal. The grain consisted of cracked corn and palay. The mash was composed of shrimp, corn meal, copra meal, rice bran, and salt. During the first four weeks infertile eggs were used to wet the corn meal given as grain or the mash.

EXPERIMENTS AND RESULTS

Plan of the experiment

The experiment was conducted for two successive years. Three hatches were made, one in December, one in February, and one in April in each year. Data of the results during the first year were disregarded, except those during the incubation. The preliminary part of the experiment enabled the writer to learn the practical side of the work, especially as to the management, care, and feeding of the chicks.

The birds were given the same treatment and raised under practically the same conditions. The feeds were weighed weekly. The initial weights of the chicks were taken at one day old, and from one week old they were weighed weekly for two months, then every second week for two more months, and monthly thereafter till the end of the experiment.

The males were separated and turned over to the Department after they were twelve weeks old and their value had been properly credited. At the end of the experiment the pullets were culled. Those selected were considered as breeding pullets and the rest were sold as table fowls.

Incubation and brooding

The eggs were all incubated in two hot-water Queen incubators (250 and 130-egg capacity). The kerosene consumption, incubator eggs removed, and the time spent for each hatching were carefully recorded.

When the chicks were hatched, they were brooded in a portable brooder house (3.6 m. $\times$ 3.3 m.) with a 500-chick Queen charcoal-burning brooder. The chicks were not allowed to go out from the brooder house until they were three days old, then they were allowed to do so only during the warmer part of the day. Within the yard, the chicks had enough exercise and much green feed in the form of grass. During the first 10 days the brooder was kept heated day and night. After that it was run only from six o'clock in the evening to about seven o'clock the following morning, except on rainy days when the chicks needed heat to keep them warm. They were kept under this condition until they were twelve weeks old, then they were put in the poultry house where they were raised till maturity.

Feeding, care, and management

The chicks were not given feed during the first twenty-four hours after hatching. The second day they were given corn meal moistened with infertile eggs. They were fed five times daily. One egg was allowed for every thirty chicks. Beginning the fourth day of the first week they were

allowed all the dry mash they wanted. After the second week, the chicks were given dry corn meal morning and afternoon and mash moistened with eggs twice a day. Dry mash was given the same as during the first week. When the chicks were four weeks old, the same procedure of feeding as given above was followed except that the mash was moistened with water instead of eggs and was given only once a day. The grain was a mixture of cracked corn and palay and was given morning and afternoon. Plenty of fresh green grass was available at all times. This procedure of feeding was followed until the end of the experiment.

The feeds were prepared weekly and the proportion (by weight) was varied according to the age of the birds. The mash was a mixture of one part shrimp, two parts copra meal, three parts corn meal, four parts rice bran, and one per cent common salt of the total mixture.

At the age of four weeks the grain given was a mixture of corn meal and cracked palay in the proportion of 1:1. The proportion of the mash was not changed until the chicks were six weeks old, when the proportion of the corn meal and copra meal was interchanged.

The grain mixture remained the same until the end of the experiment, except that a mixture of cracked corn and whole palay was given when the birds were large enough for these. From the fifteenth week, the mash mixture was again changed to one part shrimp, one part corn meal, two parts of copra meal, and three parts rice bran. The proportion of the mash was not changed again.

The birds were reared in a yard with plenty of grass. Occasionally, some pieces of wood were placed in the yard to attract white ants (*anay*), and these were exposed once in a while so the birds could get at the insects.

During the brooding period the chicks were yarded in a place protected by shade trees. These not only gave them comfort, but saved them oftentimes from their enemies, especially hawks.

Within the period of rearing, the growing chicks were closely observed. Any sign of weakness or disease in the flock was immediately given proper attention.

Man labor was not the only kind needed; animal labor was used in hauling feeds and litter for bedding from neighboring rice mills. Any amount of labor involved in the course of the experiment was properly credited.

Prices

The prices of feeds, common salt, eggs, breeding and table fowls, charcoal, and transportation were furnished by the Animal Husbandry Department of the College of Agriculture. Price of kerosene was furnished by the Property Office and of man labor by the student Labor Office of the College.

The average prices of the grain and mash mixtures were also computed (see table 1).

TABLE 1

Shows the actual prices of the different items used in the experiment

ITEMS	UNIT	PRICE
		<i>pesos</i>
Palay.....	kilogram	0.115
Corn.....	kilogram	0.0876
Shrimp, dried.....	kilogram	0.229
Corn meal.....	kilogram	0.100
Copra meal.....	kilogram	0.0696
Rice bran.....	kilogram	0.059
Salt (NaCl).....	kilogram	0.029
Grain mixture.....	kilogram	0.1013
Mash mixture No. 1.....	kilogram	0.0893
Mash mixture No. 2.....	kilogram	0.0867
Mash mixture No. 3.....	kilogram	0.0995
Charcoal.....	kilogram	0.067
Kerosene.....	can	2.57
Hatching eggs.....	hundred	10.00
Infertile eggs.....	one	0.02
D ₁ , D ₂ and D ₃ ^a	one	0.01
Table fowl.....	kilogram	
Matured fowl.....	kilogram	0.85
Broilers.....	kilogram	1.20
Breeding pullet.....	one	2.50 ^b
Man labor.....	hour	0.12
Transportation.....	hour	0.35

^aFertile eggs that died during the first, second, and third weeks, respectively.

^bThe price for which Cantonese breeding pullets are sold by the Department.

Results

The net cost of hatching 100 chicks, as shown in table 2, varies from ₱23.15 to ₱25.91. The average was found to be ₱24.26 per 100 chicks or around ₱0.24 per chick. This is higher than that found by Resananda (1924), which was only ₱0.19 for each Cantonese chick hatched. The cost of fuel and labor was not influenced by the number of eggs set.

Table 3 shows the average consumption per 100 birds by the week. The total consumption of feeds per 100 birds from the time they were fed to 24 weeks old was 264.01 kilograms of grain, 269.69 kilograms of mash, and 94 infertile eggs.

Table 4 shows the amount and cost of feed and fuel at different ages. Under the column "Average total cost per 100 birds," the cost from 4-8 weeks was lower than from 1-4 weeks.

Without deducting the cost of cockerels and the eggs laid by the pullets, as some of them matured before the experiment was closed, and adding the DISTRIBUTED charges, the total cost of producing 100 pullets to maturity was found to be ₱66.28 or an average of ₱0.66 per pullet. The chart shows the total cost of feed, labor, and average cost per 100 birds.

Table 5 shows the cost of rearing the pullets and cockerels up to the age of 12 weeks. It was found that it costs about ₱0.54 a bird.

Tables 6 and 7 show the value of cockerels at three months old and the value of the breeding and the culled pullets at maturity. The average value of cockerels raised from every 100 chicks at 12 weeks old is ₱18.88, that of pullets at 24 weeks old is ₱77.98.

The summary of all the results of the experiment shows the total proceeds to be ₱376.39; deducting the total expenses, which amounted to ₱282.94, gives a net profit of ₱93.45.

Table 8 gives the summary on cost of production expressed in percentage.

DISCUSSION OF RESULTS

Cost of hatching

The cost of hatching chicks is determined primarily by: (1) cost of the hatching eggs, (2) cost of fuel, (3) cost of labor, and (4) the DISTRIBUTED charges which include interest, depreciation, and rent. The average cost of kerosene used a day was found to be about ₱0.10. Resananda (1924) found it to be ₱0.09. He found also that the depreciation, including the rent and interest was ₱0.47 a hatch. This latter figure was used in this paper in finding the incubator depreciation and interest charges.

The cost of hatching 100 chicks varied slightly in the three different hatches. In table 2 it will be noted that the highest cost was during the April hatch when the percentage of hatch was the lowest. The cost of labor and fuel was nearly constant, for whether the 250-egg capacity incubator is filled or not, the amount of time and fuel spent will be almost the same. The average cost of hatching 100 chicks is ₱24.26 or about ₱0.24 a chick. So that if the chicks were sold at ₱0.25 each, which is the College price for a day-old Cantonese chick, there will be a gain of one centavo. The cost of a day-old chick is higher than that found by Resananda (1924), ₱0.19. The reason is that hatches were made at different seasons of the year, hence the percentage of hatches varied. The lower the percentage of hatch, the higher is the cost of hatching the chicks. Table 2 shows the computed average cost of hatching 100 chicks. The total cost of hatching 387 chicks was ₱93.50.

TABLE 2
Cost of hatching

TIME OF HATCHING	EGGS SET		INCUBATOR EGGS		COST OF FUEL AND LABOR	DISTRIBUTED CHARGES	TOTAL NET COST	NUMBER OF CHICKS HATCHED	NET COST PER 100 CHICKS
	Number	Cost	Number	Value					
		pesos		pesos	pesos	pesos	pesos		pesos
December..	255	25.50	81	1.43	3.71	0.47	28.25	122	23.15
February..	345 ^b	34.50	184	2.43	4.23	0.70	37.00	156	23.72
April.....	265	26.50	152	2.19	3.47	0.47	28.25	109	25.91
Total.....	865	86.50	417	6.05	11.41	1.64	93.50	387	24.26 ^c

^aCandled eggs after first and second week of incubation including those that did not hatch.^bTwo incubators were used during the first 14 days, then all eggs remaining were placed in one incubator.^cGeneral average.*Average amount of feed consumed at different ages*

The birds were hand-fed, care being taken not to over-feed them. They went to roost, however, with full crops. By this method of feeding, the birds were kept busy searching for bugs, insects, and worms, and were also induced to eat plenty of green grass. In this way they had ample exercise every day. Table 3 shows the amount of feed consumed at different ages per 100 birds.

TABLE 3
Amount of feeds consumed at different ages

AGE	TOTAL NUMBER OF BIRDS	TOTAL CONSUMPTION			CONSUMPTION PER 100 BIRDS		
		Grain	Mash	Egg	Grain	Mash	Egg
<i>weeks</i>		<i>kgm.</i>	<i>kgm.</i>	<i>number</i>	<i>kgm.</i>	<i>kgm.</i>	<i>number</i>
1	369	5.0	7.0	84	1.35	1.89	23
2	361	6.5	11.5	84	1.80	3.19	23
3	353	10.8	13.0	84	3.06	3.68	24
4	351	11.3	16.1	84	3.22	4.58	24
5	348	12.4	19.3	—	3.56	5.54	—
6	343	14.6	23.0	—	4.26	6.70	—
7	341	18.7	25.0	—	5.48	7.33	—
8	340	21.4	25.8	—	6.29	7.59	—
9	337	24.2	26.7	—	7.18	7.92	—
10	336	28.0	29.9	—	8.33	8.89	—
11	336	33.9	33.0	—	10.09	9.83	—
12	336	34.9	33.9	—	10.38	10.09	—
13	167 ^a	19.0	17.0	—	11.38	10.18	—
14	166	20.2	18.5	—	12.17	11.14	—
15	166	22.0	20.5	—	13.24	12.35	—
16	166	24.0	21.7	—	14.45	13.07	—
17	166	25.7	23.3	—	15.48	14.04	—
18	166	27.5	26.5	—	16.57	15.96	—
19	166	28.8	28.8	—	17.35	17.35	—
20	166	29.7	29.7	—	17.89	17.89	—
21	166	31.3	31.3	—	18.85	18.85	—
22	166	32.8	32.8	—	19.76	19.76	—
23	166	34.0	34.0	—	20.48	20.48	—
24	166	35.5	35.5	—	21.39	21.39	—
Total	—	552.2	583.8	336	264.01	269.69	94

^a Cockerels removed.

The average consumption of mash per 100 birds from the first to the tenth week was generally higher than that of grain. The reason for this was that the chicks were given enough of the mash to start them growing well. From the eleventh week to the eighteenth week, the average consumption of grain by the same number of birds was a little more than that of mash, thus supplying the birds enough heat and energy and protein for growth. From this time on the consumption of mash and grain was made practically the same. At the end of 12 weeks, a total of 167 cockerels had been removed and the consumption was naturally decreased.

Total amount and cost of feed and labor and fuel

The cost of feed, labor, and fuel are three big items in the raising of the pullets. The average cost per 100 birds at certain age and the total cost of feed, labor, and fuel from hatching to maturity are shown in table 4.

TABLE 4
Total amount and cost of feed, labor, and fuel

AGE IN WEEKS	TOTAL NUMBER OF BIRDS	FEED		LABOR ^a		FUEL		COST PER 100 BIRDS			TOTAL COST PER 100 BIRDS
		Amount	Cost	Amount	Cost	Amount	Cost	Feed	Labor	Fuel	
		kgm.	pesos	hrs.	pesos	kgm.	pesos	pesos	pesos	pesos	pesos
1-4	369	81.2									
		336 ^b	14.27	46.0	5.65	98.7	6.61	3.87	1.53	1.79	7.19
4-8	348	160.2	15.20	37.0	3.67	11.3	0.76	4.37	1.05	0.22	5.64
8-12	336	244.5	22.96	39.0	4.91	—	—	6.83	1.46	—	8.29
12-16	167	162.9	15.36	37.0	3.67	—	—	9.20	2.20	—	11.40
16-20	166	220.0	22.00	37.0	3.67	—	—	13.25	2.21	—	15.46
20-24	166	267.2	26.72	37.0	3.67	—	—	16.09	2.21	—	18.30
Total.		1136.0	116.51	233.0	25.24	110.0	7.37	53.61	10.66	2.01	66.28
		336 ^b									

^a Includes man labor and transportation.

^b Number of incubator eggs used.

Of the total amount of feed consumed, 552.2 kilograms were grain and 583.8 kilograms were mash. The number of eggs consumed was 336 and the amount of salt was 5.82 kilograms. The total cost of the feed consumed by the birds was ₱116.51.

Comparing ₱0.66, the cost of raising a pullet to maturity as found in this experiment with 43.4 cents (₱0.87) the cost reported by Philips (1916), the cost of producing pullets under local conditions, College of Agriculture, is lower by ₱0.21. The difference may be attributed largely to the kinds

of feeds given, the price of the feeds, and cost of labor, rather than to difference in conditions of the places where the birds were raised.

The pullets or cockerels at the age of 12 weeks may be sold at a reasonable profit for breeding, or as broilers. Table 5 shows the cost at the age of 12 weeks of producing the pullets and cockerels.

TABLE 5
Cost at 12 weeks old of producing the birds

ITEMS	TOTAL COST	COST PER 100 BIRDS
	<i>pesos</i>	<i>pesos</i>
Cost of hatching.....	93.50	27.83
Cost of feeds.....	52.43	15.60
Cost of labor.....	14.23	4.23
Cost of fuel.....	7.37	2.19
DISTRIBUTED charges ^a	4.53	4.53
Total.....	172.06	54.38

^a Includes interest and depreciation on the entire capital which was not affected by the number of birds.

Table 5 shows that the total cost of producing a 12-week old pullet or cockerel is about ₱0.50. At this age, the pullets and cockerels weighed on an average, 0.38 kilograms; if sold as broilers at ₱1.20 a kilogram they would bring ₱0.46. But if they are sold for breeding at ₱1.50 each, the net profit will be ₱1.00 per bird. However, a wise poultry-man will not sell his cockerels at this age as broilers, but will raise them for capons so as to get more profit from them. Usually pullets raised properly turn out to be good pullets, hence few pullets are culled from a flock for table use.

The chart clearly shows the curves of the average cost of production, feed, and labor of 100 birds at different ages. The curve for the average cost of production and that of the feed cost are almost parallel, while that of labor dropped a little from the 4-8 weeks period and increased a little from the eighth week to the sixteenth week, then maintained its level up to the twenty-fourth week.

Cost of pullets and cockerels

The raising of cockerels with the pullets until their sex can be recognized is unavoidable, until the scientific methods being developed at present can become popularized. According to Shoup (1918) it is impossible to buy

only pullet chicks or to select eggs which will produce only pullets, so that the cockerels are a necessary evil in the raising of pullets. Tables 6 and 7 show the total cost of breeding and culled pullets and cost of the cockerels after three months old.

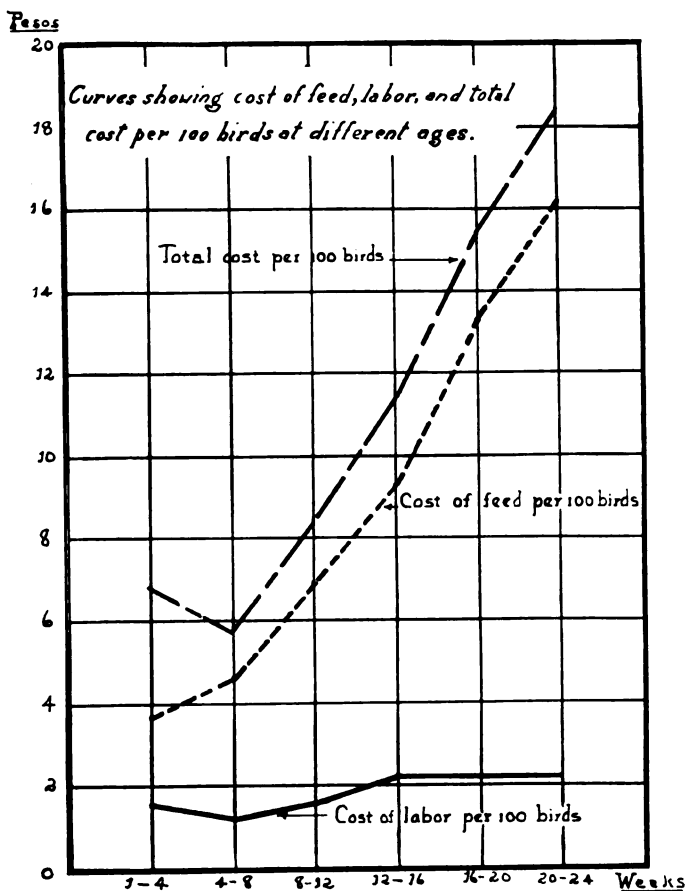


TABLE 6
Value of cockerels at 12 weeks old

TIME OF HATCHING	NUMBER OF CHICKS HATCHED	NUMBER OF COCKERELS	TOTAL WEIGHT	AVERAGE WEIGHT	TOTAL VALUE AT P1.20 A KGM.	VALUE OF COCKERELS RAISED FROM EVERY 100 CHICKS
			kgm.	kgm.	pesos	pesos
December.....	122	62	22.57	0.364	27.08	22.10
February.....	156	60	20.64	0.344	24.77	15.88
April.....	109	45	17.68	0.393	21.22	19.47
Total.....	387	167	60.89	0.367 ^a	73.07	18.88 ^b

^a General average.

^b Value of cockerels raised from every 100 chicks based on the total number of chicks and total value of cockerels.

TABLE 7
Value of pullets at 24 weeks old

TIME OF HATCHING	NUMBER OF CHICKS HATCHED	NUMBER OF PULLETS	SELECTED PULLETS		CULLED PULLETS			TOTAL VALUE	VALUE OF PULLETS RAISED FROM EVERY 100 CHICKS
			Number	Value at ₱2.50 each	Number	Total weight	Value at ₱0.85 a kgm.		
				pesos		kgm.	pesos	pesos	pesos
December...	122	46	32	80.00	14	11.88	10.10	90.10	73.85
February...	156	72	48	120.00	24	20.59	17.50	137.50	88.14
April.....	109	48	22	55.00	26	22.58	19.19	74.19	68.06
Total.....	387	166	102	255.00	64	55.05	46.79	301.79	77.98 ^a

^aValue of pullets raised from every 100 chicks based on the total number of chicks and total value of pullets.

The separation of the cockerels from the pullets gave the latter more room for growing and freed them from being annoyed by the aggressive vigorous cockerels. The value of the cockerels at the age of 12 weeks was ₱73.07 and the total value of all the pullets when 24 weeks old was ₱301.79. The value of twelve weeks old cockerels and twenty-four weeks old pullets raised from every 100 chicks was found to be ₱18.88 and ₱77.98, respectively.

SUMMARY OF RESULTS

The details of the results of the experiment are summarized as follows:

(a) Receipts:

102 breeding pullets at ₱2.50.....	₱255.00
64 culled pullets (55.05 kgm.) at ₱0.85 per kgm.....	46.79
167 cockerels as broilers (60.89 kgm.) at ₱1.20 per kgm.....	73.07
51 eggs ^a (under sized) at ₱0.03.....	1.53
Value of manure ^b .....	.....
	₱376.39

(b) Expenses:

Cost of hatching 387 chicks.....	₱93.50
552.2 kilograms of grain feed at average price, ₱0.1013.....	55.91
583.8 kilograms of mash feed at average price, ₱0.092.....	53.71
5.82 kilograms of common salt at ₱0.029.....	0.17
336.0 infertile eggs at ₱0.02.....	6.72
233.0 hours labor and transportation.....	25.24
110.0 kilograms charcoal at ₱0.067.....	7.37

Capital charges:

Interest on investment on hatching eggs (₱86.50) for 9 months at 5 per cent per annum	3.24
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^aA few pullets laid eggs before they reached the age of 24 weeks.

^bValue of manure credited for green feed.

Interest on cost of 1 coal burning brooder and 1 brooder house (₱197.50) for 6 months at 10 per cent per annum.....	9.84
Depreciation at 10 per cent per annum.....	9.84
Interest on cost of 180 meters fencing (₱56.00) for 9 months at 10 per cent per annum.....	4.20
Depreciation at 10 per cent per annum.....	4.20
Interest on cost of poultry house (₱30.00) for 9 months at 10 per cent per annum.....	2.25
Depreciation at 10 per cent per annum.....	2.25
Interest on the land used (50 m. × 40 m.) (Valued ₱60.00) for 9 months at 10 per cent per annum.....	4.50
Total expenses.....	₱282.94

(c) Net Income:

Gross receipts.....	₱376.39
Total expenses.....	282.94
Net income.....	₱93.45

The value of the manure was considered enough to pay for the value of the green feed eaten by the birds.

It is interesting to note that out of 387 chicks, 167 cockerels raised to three months old, and 166 pullets to maturity, a period covering almost ten months, gave a net profit of ₱93.45. The amount of labor spent a day averaged only 1.7 hours. It was found also that to raise 100 pullets one needs 521 eggs. The total expenses in the raising of 166 pullets to maturity was ₱282.94, and the value of the cockerels when 12 weeks old was ₱73.07. Deducting this from the total expenses of raising the pullets, the net cost of raising 166 pullets was 209.87 or ₱1.26 per pullet.

Table 8 shows the principal items involved in the raising of the pullets.

TABLE 8
Summary on cost of production

ITEMS	TOTAL COST	
	pesos	per cent
Cost of hatching 387 chicks.....	93.50	33.05
Cost of feeds.....	116.51	41.18
Cost of labor and transportation.....	25.24	8.92
Cost of fuel.....	7.37	2.60
DISTRIBUTED charges.....	40.32	14.25
Total.....	282.94	100.00

By reference to table 8 it may be seen that the three largest items involved in the cost of production of the pullets were: (1) cost of hatching the chicks, (2) cost of feeds and (3) capital charges comprising 88.48 per cent of the total cost of raising the pullets. In spite of the low percentage of hatch, the net profit is 21.73 per cent on a total investment of ₱430 and

109.3 per cent on the investment of ₱86.50 on hatching eggs. Comparing the latter figure with that of Withycombe (1905), which was 180 per cent, the margin of difference is rather large. This difference may be due to the difference in local conditions, which may include (1) feed prices, (2) cost of labor, (3) cost of fuel, (4) breed of chicken used, (5) market value of products, (6) time of hatching, and (7) method of raising the birds, or more likely, to method of computation.

Some factors affecting production

The principal factors that affect the raising of poultry are (1) prices of feeds, (2) percentage of hatch, (3) mortality, (4) diseases, (5) poultry enemies, (6) feeding, care and management, and (7) climatic conditions.

The prices of feeds as given under "Prices" are probably much higher here than in other parts of the Philippines. The average percentage of hatch was rather lower than what was expected. However, it was fair. So far as diseases and enemies of the chickens are concerned, the birds did not suffer from them as they were protected as much as possible by proper management and care. As to climatic conditions, they are beyond the control of man.

SUMMARY AND CONCLUSIONS

1. The average net cost of hatching 100 Cantonese chicks was found to be ₱24.26, or around ₱0.24 per chick.

2. The amount of feeds needed to raise 100 pullets to 24 weeks was 264.01 kilograms of grain, 269.69 kilograms of mash, and 94 incubator eggs.

3. The net cost of producing 100 pullets was found to be ₱126.43. The total cost of feeds was ₱116.51, of labor ₱25.24, and of fuel ₱7.37.

4. The amount that was realized from cockerels of 12 weeks old was ₱73.07 and from the pullets at 24 weeks old, ₱301.79. In other words the total sum realized from 865 hatching eggs which gave 387 chicks, was ₱374.86.

5. The separation of the cockerels from the pullets at the age of twelve weeks gave more room for the growing pullets and the pullets were saved from being annoyed by the aggressive and maturing cockerels.

6. The largest items in the raising of pullets were (1) cost of hatching chicks, (2) cost of feeds, and (3) capital charges.

7. The total cost of raising the pullets and cockerels from egg up to 12 weeks old was ₱172.06, or around ₱0.54 a bird.

8. It was found that 521 hatching eggs were necessary to raise 100 pullets.

9. By raising 166 pullets to maturity, the net income was found to be ₱93.45.

10. The cost of hatching, of feeds, and the capital charges was found to be 88.46 per cent of the total cost of production. The net income was 21.73 per cent based on the total investment.

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NOTE: LOS BAÑOS BIOLOGICAL CLUB

At the twenty-sixth scientific meeting of the Los Baños Biological Club held March 3, 1927, the last for the college year 1926-1927, election of officers for the ensuing year was held. Dr. A. K. Gomez of the College of Veterinary Science was elected president, and Dr. F. M. Fronda of the College of Agriculture, secretary. At the close of the meeting, Dr. L. B. Uichanco, the retiring president, read the following report:

The following is a brief report on the activities of the club during the college year 1926-1927:

Number of meetings held.....	7
Total number of departments which presented papers...	7

Number of papers read, listed by departments (detailed list, as compiled by the retiring secretary, Dr. A. K. Gomez):

Agronomy.....	3
Animal Husbandry.....	7
Chemistry.....	1
Plant Pathology.....	1
Plant Physiology.....	1
Entomology.....	1
College of Veterinary Science.....	5
Total.....	19

While the number of meetings, as well as number of papers read, was somewhat smaller than in past years, yet it can be pointed out with pride and without fear of successful contradiction that the commendable precedent established by past administrations in maintaining a uniformly high quality of material and insisting that only products of original research be reported on programs of the Club was closely adhered to. Moreover, without attempting to offer apologies, it may be noted for purposes of record, that this slight reduction in number of meetings and of papers read was due to causes beyond our control, among these being the unusually bad weather prevailing, which culminated in the severe typhoon of November 5, 1926, which interfered with cultures in many departments; diversion of activities of not a few members in preparing papers for scientific meetings of other organizations; and absence from the Campus for a large part, or for the entire year, of three of the most energetic and productive contributors.

Judging from the continued interest and enthusiasm of the members, as seen from the large attendance at each meeting and the increasing proportion of members taking part in discussions of papers, the Club gives promise of a long, healthy, and progressive existence.

The retiring officers desire to express their thanks to all the members for giving them this opportunity for service, and for their generous co-operation. We bespeak for the incoming officers the same hearty support.

The list of papers read before the Los Baños Biological Club during the academic year 1926-1927, was appended to the retiring president's annual report and follows:

List of papers read before the Los Baños Biological Club during the academic year 1926-1927:

Agronomy Department

1. Dr. Vicente C. Aldaba—Differentiation of canton fiber from abacá.
2. Dr. Nemesio B. Mendiola—Natural crossing in rice and its relation to rice improvement.
3. Mr. Pedro A. Rodrigo—Growing of peanuts from cuttings.

Animal Husbandry Department

1. Dr. B. M. Gonzalez—Experience in the Philippines with the introduction of pure breed animals to improve the common stock.
2. Dr. F. M. Fronda—Studies on the fertility of the hen's egg.
3. Dr. B. M. Gonzalez—Observations on the duration of service and serviceable life of work cattle.
4. Dr. M. Mondofredo and Mr. P. Bayan—A comparative study of corn and cassava as feeds for hogs.
5. Dr. Valente Villegas and Mr. A. D. Pablo—A preliminary study on the dairy qualities of goats.
6. Dr. B. M. Gonzalez—Observation on education and research in Japan—agricultural and general (with lantern slide illustrations).
7. Dr. F. M. Fronda—A short cut method for determining approximately profits and losses in a poultry project.

Chemistry Department

1. Dr. F. O. Santos and Mr. E. Collado—The nutritive value of sweet potato: I. The anti-nutritive properties of the leaves and shoots.

Plant Pathology Department

1. Dr. G. O. Ocfemia—The bunchy top of abacá.

Plant Physiology Department

1. Mr. Fernando de Peralta—Growth and development of young rice plants grown in complete culture solution to which NaCl was added.

Entomology Department

1. Dr. L. B. Uichanco—Insects in relation to the introduced cultivated element of the Philippine flora.

Veterinary College

1. Dr. Manuel Robles—A résumé of the causes, classes and occurrences of accidental wounds among domesticated animals.
2. Dr. Marcos Tubangui—Laboratory studies on surra with special reference to the nature of the immunity following the cure of experimental infections.
3. Dr. Zacarias de Jesus—Cysticercosis in the native swine.
4. Dr. G. San Agustin—Meat inspection work in relation to public health in the Philippines.
5. Dr. A. K. Gomez and Dr. Z. de Jesus—The production of biological products in the College of Veterinary Science.

The Los Baños Biological Club is composed of the Los Baños faculty members of the University of the Philippines, who are interested in biological research. One feature of this organization is that it has no constitution,

only six brief and simple "rules of conduct." The number of officers has been reduced to a minimum, a president and a secretary.

The Los Baños Biological Club was organized November 15, 1923. The first scientific meeting was held December 4, 1923, and scientific meetings have been held regularly each month, except during the summer months, since organization. Since its foundation, seventy-four scientific papers have been presented. These are distributed among the different departments of the Los Baños Colleges as follows:

	1923-1925 ^a	1925-1926	1926-1927	Total
Agricultural Engineering.....	1	1	0	2
Agronomy.....	5	6	3	14
Animal Husbandry.....	4	3	7	14
Chemistry.....	2	1	1	4
Entomology.....	2	2	1	5
Forestry.....	1	0	0	1
Medical Department.....	0	1	0	1
Plant Pathology.....	4	4	1	9
Plant Physiology.....	4	3	1	8
Veterinary College.....	5	6	5	16
Total.....	28	27	19	74

^a Covering a period of from December 1923 to March 1925.

F. M. FRONDA, *Secretary*.

ABSTRACT¹

A study of the root system of rice. EMILIO T. DAVID. (*Thesis presented for graduation, 1926, with the degree Bachelor of Agriculture, from the College of Agriculture No. 250; Experiment Station contribution No. 447.*)—The author studied the root system of rice as affected by different soil conditions and different amounts of water. He used 28 varieties of lowland rice for the study of the root zones and 18 varieties of upland rice for the study of growth and feeding area of roots.

A pit was dug near each plant and the spread, depth of penetration, and strata where the most roots were found were noted. In connection with this, the author made note of the spread, depth, and weight of the roots of both upland and lowland rice. He further studied the correlation of the root development of the seedling to its future development. In the study of the effect of soil, clay loam, silt, clay, and sand were the types used with five plants each in each series. Lowland rice was studied for the root development 25 and 50 days after sowing; for feeding area, studies were made after 68 days. The length of the roots were measured by the aid of a hand lens and a millimeter calibrated board.

The author found that variation in the root system within the variety is not marked, but in the different varieties, marked differences were noted. The contrast was particularly true in the case of lowland rice.

The roots of Tiniaong and Vinalintin have greater penetration, spread, and depth than the other varieties studied.

The spread of the root system is not positively correlated with the depth, and the root development of seedlings is not an index to the future behavior of the plants.

The feeding area of the different caiñgin rice varieties was marked under the same treatment and conditions.

The root systems of lowland rice are larger in size and softer than in the upland varieties. Upland rice has the tendency to ramify profusely.

Among the five degrees of saturation, the longest roots were found in the soak culture. With increase of water supply there was increase in length, width, and weight of the roots.

The weight of the roots was found to be proportional to the weight of shoots.

Clay loam gave the heaviest, greatest number, and longest root developments.

—Abstract by Simplicio Oliveros.

¹ Abstract prepared as part of required work in English 6, College of Agriculture.

HE CANNOT READ HIS TOMBSTONE WHEN HE'S DEAD

If with pleasure you are viewing any work a man is doing
If you like him, if you love him, tell him now;
Don't withhold your approbation till the parson makes oration
And he lies with snowy lilies o'er his brow.
For no matter if you shout it he won't really care about it,
He won't know how many tear-drops you have shed;
If you think some praise is due him now's the time to slip it to him,
For he cannot read his tombstone when he's dead.

More than fame and more than money is the comment kind and sunny
And the hearty, warm approval of a friend,
For it gives to life a savor and it makes you stronger, braver,
And it gives you heart and spirit to the end;
If he earns your praise, bestow it; if you like him, let him know it,
Let the word of true encouragement be said;
Do not wait till life is over and he's underneath the clover,
For he cannot read his tombstone when he's dead.

—*Cultivator* (California).

The business world will never forget the incident when the late J. Pierpont Morgan appeared before a Congressional Committee at Washington and was asked what was the greatest credit asset in the financial world. And as a room full of spectators and a table full of press representatives, who were to telegraph the answer to every part of the country, leaned forward to hear the reply, there rang out like a pistol shot, into a room so quiet that you could hear a pin drop, the one word "CHARACTER."—EDWARD BOK.

"God, give us men. A time like this demands
Strong minds, great hearts, true faith, and ready hands;
Men whom the lust of office does not kill;
Men whom the spoils of office cannot buy;
Men who possess opinions and a will;
Men who have honor—men who will not lie;
Men who can stand before a demagogue
And scorn his treacherous flatteries without winking;
Tall men, sun-crowned, who live above the fog
In public duty, and in private thinking."

—J. G. HOLLAND.

EXCHANGE NOTES

A very comprehensive bibliography of books and pamphlets pertaining to youth and the farm has been published recently in mimeograph form by the U. S. Department of Agriculture. A total of 128 books are listed and briefly reviewed, and a good index is provided. If you can use a copy of this, write to department.

—*Extension Letter*. (University of Hawaii).

At the National Dairy Show in Detroit when Gertrude Kaiser won highest individual honors in the national junior dairy cattle judging contest there were but four girls in the contest. Before going to Detroit, Gertrude had walked off with the state championship for Iowa in junior dairy cattle judging at the Dairy Cattle Congress. In that contest, 125 boys participated and five girls.

—*Successful Farming* (Iowa).

The students enrolled in the vocational agricultural courses throughout the state realized an average of \$1.09 per hour on the time spent on their home projects for last year. This work is required of all those enrolled in the Smith-Hughes agricultural courses. It is the means by which experience is obtained to correlate with the agricultural instruction in the classroom. The type of project carried by each student is selected on the basis of the interests of the student, his probable ambitions as a farmer, and upon the amount of practical experience and education it is possible to obtain from the enterprise. These projects vary in type and scope from the caring of 15 acres of orchard to the raising of 1,000 baby chicks, or the production of ten acres of beans to the raising of three pure breed heifer calves.

In all there were 1,466 projects carried with a total profit of \$144,772.29, or an average of \$98.75 per student. Many students in addition to having had excellent preparation for their future as farmers, have been able to make enough money to pay their way through an agricultural college.

—*Cultivator* (California).

The area under rice cultivation (in Siam) has increased from 7,300,000 to approximately 17,700,000 rai (2,885,000 to 7,980,000 acres), and the quantity of rice exported has risen from 8 to an average of over 18 million piculs. That was the average in normal years till recently, but in the three years 1921-22 to 1923-24 it was over 21 million piculs, falling to 19.2 mil-

lions in 1924-25 and rising to 22.9 million piculs in 1925-26. The production has increased correspondingly, and in a good year is now quite 82 million piculs of paddy, in addition to which a balance of 14 million piculs will have been brought from the previous year, making a total of 86 million piculs to be dealt with. Of this total 5 million piculs are retained for seed, 45 to 50 million piculs are used as food, and from 27 to 32 million piculs are exported, leaving 14 million piculs to carry forward. These are the paddy figures for the whole Kingdom, and are somewhat smaller when converted into rice figures. In the seven principal provinces the area under paddy in 1925-26 was 10,192,200 rai (4,076,880 acres), and the yield was 37,126.070 piculs (2,209,888 tons). The damaged area was unusually large.

It is estimated that the population is increasing at the rate of 11 per thousand. The estimated population for the current year is about 10 millions.

—*The Directory for Bangkok and Siam* (1927).

Pigs will eat partially or fully ripened bananas as readily as will human beings, but of course it is only damaged, small, or ill-shaped fruit that could be profitably used as a pig feed. But it should be borne in mind that it would certainly pay better to feed them in combination with milk, maize, maize meal, sweet potatoes, or other farm crop than to attempt to feed them as the principal food given to the pigs.

—*Agricultural Journal* (Queensland).

The exports of cocoa from the Gold Coast (West Africa) have increased to over 223,000 tons, representing a value, even at present low values of nearly £9,000,000 (nine million pounds), and all is unfermented cocoa. This flood of inferior cocoa has altered the market; the manufacturers have to take it and make the best of it. But manufacturers of cocoa powder and chocolate would prefer fermented cocoa if they could get it in sufficient quantity; some manufacturers still use nothing else, others use both kinds and blend, others only the cheapest.

—*Agricultural Society Journal* (Jamaica).

There are various references in entomological literature to solutions for preserving books in the Tropics from attack by insects. The following is effective.

- 1/4 oz. creosote
- 1 oz. corrosive sublimate
- 1 oz. carbolic acid
- 2 pts. methylated or white rum spirit

—*Agricultural Society Journal* (Jamaica).

COLLEGE AND ALUMNI NOTES

Science and the Common Farmer, editorial by Dean Baker in THE PHILIPPINE AGRICULTURIST, June, 1926, was reprinted in *The Journal of the Madras Agricultural Students' Union* for July, 1926.

Sugar Cane Breeding in the College of Agriculture: IV. Training sugar cane plants for convenient pollination work, by Toribio Mercado which appeared in THE PHILIPPINE AGRICULTURIST, February, 1926, was mentioned editorially by *The Tropical Life* of August, 1926.

Selection of Mosaic Free Cuttings of Sugar Cane by J. O. Unite and J. M. Capinpin, which appeared in the July, 1926, issue of THE PHILIPPINE AGRICULTURIST was reprinted in full in *The Planter and Sugar Manufacturer* in its August 21, 1926, issue. The same article was abstracted in the *Review of Applied Mycology*, 5: 764-765, December, 1926.

The College was honored by several Japanese visitors of note in February and March. Among these were Mr. Yoshifusa Iida, stock-farm expert of the Formosan Government. He inspected the College, particularly the Animal Husbandry Department, and consulted with our animal-husbandmen. Major Kenji Matsumoto and Major Yorimichi Suzuki, of the Japanese army who were here on February 16, were especially interested in horse breeding. On March 21, a party consisting of one professor from an agricultural school and thirteen principals of public schools in Korea spent several hours on the Campus.

Professor David L. Crawford, for a number of years a member of the staff of the University of Hawaii, has been appointed President of this University. Professor Crawford was a student of Dean Baker's, some twenty-three years ago, at Pomona College, California.

Miss Kathleen MacGregor Davis of London was house guest at Cope-land House for a few days in March. Miss Davis is a graduate of the Women's Agricultural College at Swanley, Kent, England, specializing in horticulture. The courses in this college, according to Miss Davis, are no lily-handed jobs. All the manual labor, spading, raking, handling manure, painting greenhouses, etc., is done by the students. The outside, or manual labor totals about seven hours a day. On this work full notes on observations are kept. Two to three hours lectures are given daily.

Students taking the agricultural course do all field work, plowing, harvesting, etc. Many of the students are daughters of titled fathers and of men of wealth. They are studying that they may know how to manage their own gardeners and estates. They are shown no favors in the college work. Many graduates go right into good jobs, as in Kew Gardens or as head gardeners on estates. While here, Miss Davis climbed Mount Maquilung and was most enthusiastic over its flora wonders and beauty.

Dr. W. H. Brown, Director, Bureau of Science and Dr. Otto Reinking were Campus visitors in March. Doctor Reinking sailed for the United States by way of Panama, early in April, after some two years spent in the East and Australia seeking new varieties of banana for the United Fruit Company. Doctor Reinking is Plant Pathologist for the Company.

Mr. Ramón Misa, Superintendent of Iwahig Penal Colony, was a college visitor in February. Mr. Misa was formerly superintendent of San Ramón Penal Farm.

Mr. H. T. Edwards, Specialist in Fiber Plant Production with the United States Bureau of Plant Industry and Doctor Sherman of the Bureau of Science, Manila, were Campus visitors recently. They came to confer with Doctor Aldaba, of the Fiber Division and Doctor Ocfemia of Plant Pathology.

T. F. O'Leary, for three years assistant professor of English, sailed for the United States *via* Europe on *S. S. Trier*, March 21.

Wealth Awaits You on the Farm, issued as College Circular No. 12 is a striking prospectus of the College. The cover is a half-tone showing a live scene around a rice thresher. "A Message to the Young Men of the Philippines" is the caption on the first page. This message is strengthened by several half-tones of college buildings, exterior and interior, athletic groups and "lab" groups. The pages giving in brief the courses are enlivened by many half-tones showing what we do here. The last page carries in special type "Higher Education in Agriculture Leads to Economic Independence." All in all this is a circular with spirit. It was prepared especially for circulation among high school graduates with the query "What shall I do?" facing them.

The College of Agriculture Class of '27 graduated by the University of the Philippines numbers 43.

*For the Degree of Bachelor of Agriculture
(General Curriculum)*

Aves, Leopoldo	Medrana, Constancio T.
Briones, Buenaventura C.	Morales, Eufraín
Eala, Quintín	Muyargas, Agapito
Español, Filemon	Palisoc, Eleuterio
Gamo, Enrico B.	Paller, Enrique
Inciong, Antero	Robin, Pascual
Lacuesta, Gabriel	Sumagit, Felix S.
Lina, Valentin K.	Tugade, Primitivo
Macasaet, Emilio	Urbino, Cornelio
Caliñgasan, Martin G.	

*For the Degree of Bachelor of Agriculture
(Animal Husbandry Curriculum)*

Limpiado, Leoncio	Paje, Pedro S.
Ordoveza, Fernando C.	Serrano, José
Villanueva, Ceferino	

*For the Degree of Bachelor of Science in Agriculture
(General Curriculum)*

Antipolo, Petronilo	Etorma, Severino
Arnaldo, Marcelo V.	Flores, Nicomedes
Balagtas, Amado	Florida, Vicente
Cruz, Amado J. de la	Florita, Numeriano
Derecho, Constantino	Oliveros, Simplicio
Durano, Antonio	Valenzuela, Pedro D.
Estañol, Juan D.	Villar, Ulpiano

*For the Degree of Bachelor of Science in Agriculture
(Supplementary Curriculum)*

Bayan, Paterno	Lopez, Victoriano
Gonzales, Salustiano S.	Reyes, Fidel M.
Villanueva, Leopoldo J.	

Benjamin Hollero was awarded the Joaquin J. Gonzalez Medal and Student Council Gold Medal, both for highest scholarship during the course. Pedro S. Paje was awarded the Class '25 Medal for the best thesis.

An unusually large number of the graduates are going directly into agriculture, on their own or father's farms, or on coconut plantations, managers of poultry farm, or in sugar centrals.

The Summer School enrollment numbered 370. Twelve of these came for the special course in Poultry Raising.

There were three students doing special work in cattle husbandry.

Doctor Research to the Rescue, a dramatic agricultural demonstration, was presented by the English Department, January 28, in the College Auditorium to an invited audience. This was the first attempt in the College to show the value of the drama in popularizing technical agriculture. On request from the head of English Department, Associate Professor Yule, five graduate assistants each wrote a scene demonstrating one phase the work in his department. Miss Wilson of the English Department wrote a prologue and arranged these five scenes for presentation.

The scenes were: *Prologue*: by Miss Margaret C. Wilson. *Scene I*: Stock and Stockmen Come for Aid, by Mr. Paterno Bayan, Animal Husbandry Department, and Mr. Enrique Paller. *Scene II*: Feminine Vanity is Satisfied, by Mr. Edilberto Punzalan, Department of Agronomy. *Scene III*: Mr. Vitamin Defeats Mr. Beriberi, by Mr. Esteban Collado, Chemistry Department. *Scene IV*: The Romance of Miss Rice and Mr. Soil, by Mr. Artemio V. Manza, Plant Physiology Department. *Scene V*: A Plant Disease Clinic, by Mr. Macario Palo, Plant Pathology Department.

Twenty-six characters appeared in the drama. The most important, of course, was Doctor Research which was ably interpreted by Pascual Robin. The costumes were designed by Mr. Moisés Villaluz and Mr. Vicente Dawis. Miss Margaret C. Wilson of the Department of English directed the play.

On March 1, was the Annual General Inspection of the Cadet Corps by Major Escott B. Miller, U. S. A. Military Commandant for the University, and Major Edwin H. Hardy of the General Staff, U.S.A., and Captain George F. Bloomquist, U.S.A. The Annual University Medals were awarded to the following cadets:

Leadership Medal to Cadet Captain Brígido A. Huligaña; awarded for highest quality of command and leadership.

Efficiency Medal to Cadet Captain Agustin Hermano; awarded to the cadet captain commanding the winning company.

Honor Medal to Cadet Sergeant Delfin Española; awarded for highest record in obedience to rules and regulations of the Department and discipline in ranks and classes.

Loyalty Medal to Cadet Private Anacleto Espinas; awarded for the most perfect attendance, an average grade of at least 2, and for highest record in helpfulness to the Department throughout the year.

Duty Medal to Cadet Private Anacleto Coronel; awarded for the most perfect attendance, and an average grade of at least 2.

Marksmanship Medal to Cadet Major Narciso Lofrades; awarded for the best record on the range for the year.

The following cadets also received medals during the year 1926-1927:

U. P. Team Medals.....	{	Cadet Private Justo Capili
		Cadet Corporal Baldomero Salinas
		Cadet Private Francisco Gestoso
		Cadet Private Felix Enrile
		Cadet Private Bernard Wideman
		Cadet First Sergeant Fernando Fernandez
Marksman (Rifle C).....	{	Cadet Major Marciso Lofrades
		Cadet Private Victoriano Aviguetero

Professor Higgins wrote Dean Baker from Los Angeles that Mrs. Higgins is slowly improving in health. But the physicians are definite in their decision that she must not return to the Orient.

Mr. Dionisio Aquino, B. S. '23, now studying in Iowa State College, writes that he has been appointed a Fellow in the Department of Soils. This appointment carries a salary of \$60 (P120) a month. "Competition for jobs among self-supporting Filipino students is keen," Mr. Aquino writes. "Washing dishes, beating rugs, serving oil and gas to motorists from four to eleven in the evening are popular occupations. My old violin is responsible for part of my earnings. Every night I play at the College Inn Cafeteria for 45 minutes for my three meals a day. I oftentimes play for dances, and at banquets, where I get from \$5 to \$8 for two or three hours playing."

Mr. Feliciano Reveche, B. Agr. '23, recently turned down a "white collar job" for the farm.

"I rejected the offer of to me, because I have now decided to stay on the farm. At present I am doing some truck gardening, and managing a big plantation of abacá, coconut, rice, and a herd of 40 cows. To be a manager is a big job—the manager always has new problems to be solved every day, right in the field."

Mr. Artemio V. Manza, B. S. '23, graduate assistant in Plant Physiology, sailed for the United States on *S. S. Empress of Canada*, April, 1927. Mr. Manza expects to continue his studies in the College of Agriculture, University of California, Berkeley. Before he left the College Campus, a gay dinner was given in his honor by the staff of the Department of Plant Physiology at Molawin Hall. Mr. Pascual Robin, B. Agr. '27, will take Mr. Manza's place during his sojourn in the United States.

Mr. Fernando de Peralta of the Department of Plant Physiology spent his vacation with his home folks at Claveria, Cagayan.

Mr. Emilio David, B. Agr. '26, was a special student in Cattle Husbandry during the Summer Session. Mr. David reports success on his father's rice farm in San Miguel, Bulacan, with application of methods and knowledge gained in the College. He is an enthusiastic booster for technical education for farmers. He is planning to branch out into cattle raising. Wisely, he comes to the spring furnishing knowledge on this subject for a drink before buying his cattle.

Mr. Pedro S. Paje, B. Agr. '27, will be manager of a poultry farm in Baclaran, Parañaque, Rizal. Mr. Paje gets a good salary and liberal percentage of profits. Mr. Paje's medal thesis was on cost of raising pullets.

Mr. Fernando V. Ordoveza, B. Agr. '27, is managing his father's farm in Sta. Cruz, Laguna. He went to Tayabas the middle of April to locate a ranch. He expects to farm for two years after which he plans to go to the United States to travel and get information regarding agricultural enterprises.

*New books and other publications added to the Library, College of Agriculture
from January 1 to April 7, 1927*

Annual report of the Bureau of American Ethnology to the Secretary of Smithsonian Institution. 1919.

Crittenden, J. J.

Calendar of the papers of Crittenden, J. J.

Directory of Bangkok and Siam. 1927.

Fitzpatrick, J. C.

List of the Washington manuscripts from the year 1592-1775.

Franklin, Benjamin

Papers of Benjamin Franklin in the Library of Congress. 1905.

Gregory, J.

Catalogue of early books on music in the Library of Congress. 1913.

Griffin, A. P. C.

A union list of periodicals, transactions, etc. 1901.

Haas, T. and Hill, T. G.

An introduction to the chemistry of plant products. 1921. Vols. 1 and 2.

Heilprin, A. & L. (eds.)

A complete pronouncing gazetteer of geographical dictionary of the world. 1922.

Ingram, J. Van Ness

A check list of American eighteenth century newspapers. 1912.

International Association of Instructors and Investigators in Poultry Husbandry: Proceedings of the meetings for the years 1908-1910.

Johnston, W. D.

History of the Library of Congress. 1904.

Lane, W. C.

A. L. A. Portrait index in the Library of Congress. 1906.

Library of Congress:

American and English genealogies. 1919.

A check list of American newspapers. 1901.

Check list of collections of personal papers. 1918.

Copyright decisions, 1918-1924 (Bull. No. 19).

Copyright decisions of U. S. courts, 1913-1914 (Bull. No. 17); 1914-1917 (Bull. 18).

Handbook of manuscripts. 1918.

Manuscripts in public and private collections in the U. S. 1924.

Lowery, B.

Descriptive list of maps of Spain. 1912.

MacCurdy, R. M.

A history of the California Fruit Growers Exchange. 1925.

Monroe, James (Library of Congress)

Papers of James Monroe in the Library of Congress. 1904.

National Library of Wales

A bibliography of Robert Owen, the socialist. 1925.

Biblioteca celtica for 1910-1918.

Catalogue of manuscripts. 1921. Vol. 1.

Catalogue of oriental manuscripts, Persians, Arabic and Hindustans. 1916.

Catalogue of tracts of the civil war and commonwealth period relating to Wales and the borders. 1911.

Naval record of the American revolution, 1775-1788.

New Zealand official yearbook. 1927.

Noyes, C. S.

Noyes collection of Japanese prints. 1906.

Official yearbook of the commonwealth of Australia. 1926.

Palmer, T. W.

Guide to the law and legal literature of Spain. 1915.

Pardo de Tavera, T. H.

Biblioteca Filipina. 1903.

Parsons, A. J.

Catalog of the Gardener Greene Hubbard collection of engravings. 1905.

Pearl, R.

Introduction to biometry (medical) and statistics. 1923.

Philippine Sugar Industry.

Handbook. 1927.

The Philippinesian. 1926.

Phillips, P. L.

A list of atlases and maps applicable to the world war. 1918.

A list of geographical atlases in the Library of Congress. Vols. 1-4.

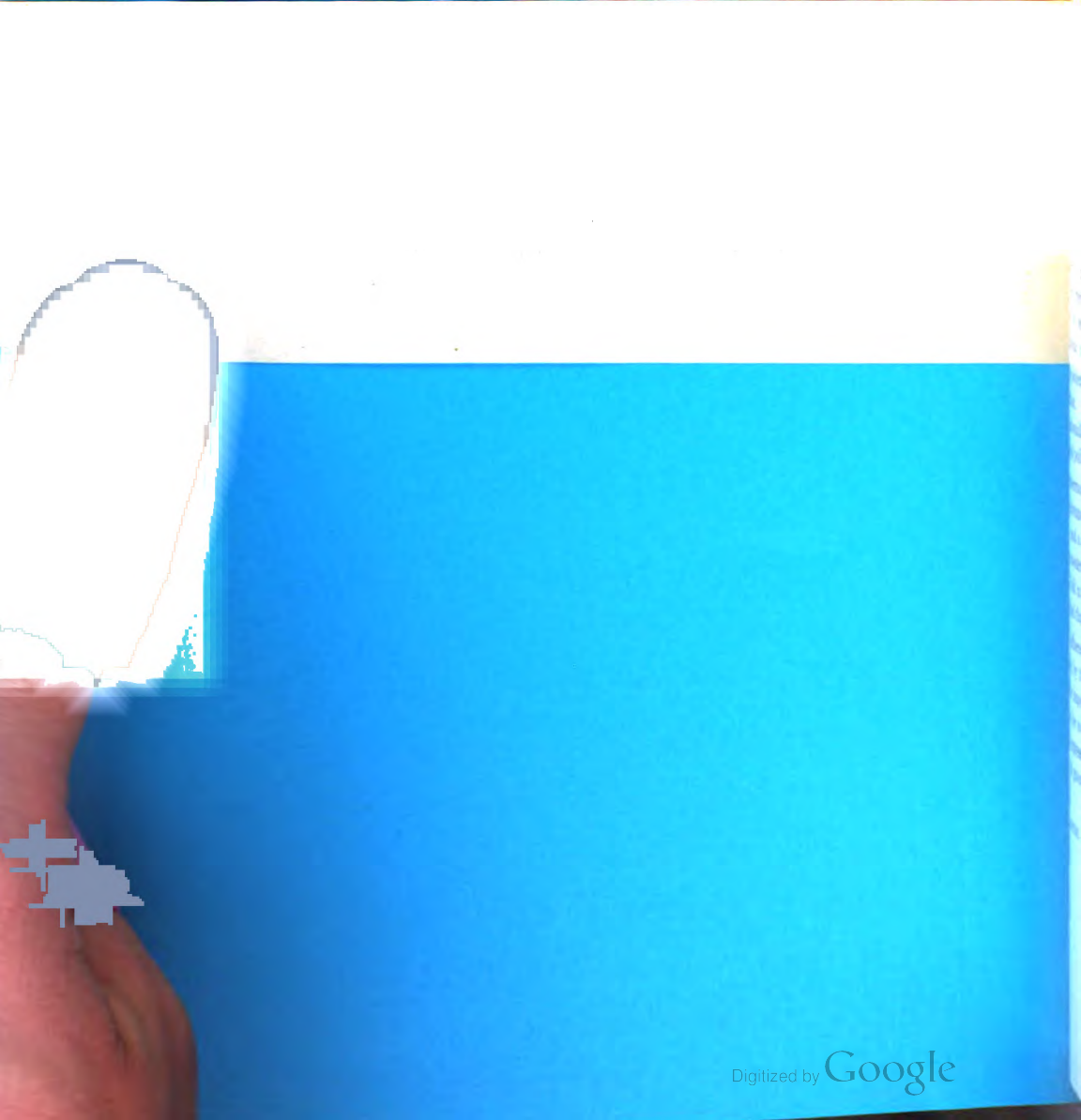
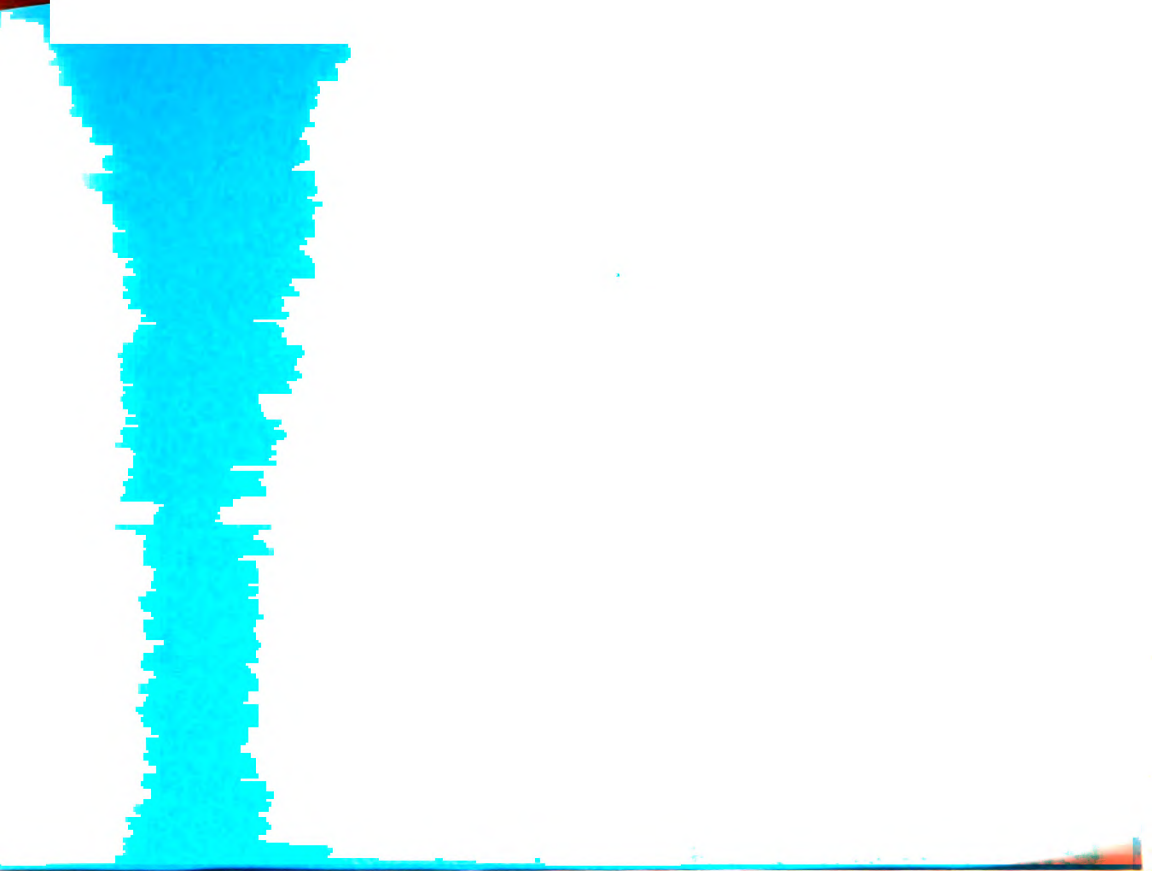
A list of maps of America in the Library of Congress. 1901.

A list of works relating to cartography. 1901.

- Proceedings of the second conference of teachers of International Law and related subjects. 1926.
- Report of the Librarian of Congress
1898-1899, 1901-1926.
- Report of the progress of agriculture in Mysore. 1926.
- Solberg, T.
Copyright in Congress. 1789-1904.
- Sonneck, O. G.
Dramatic music in the Library of Congress. 1908.
- Subject headings used in the dictionary catalogues of the Library of Congress. 1919.
- Tripp, G. E.
Electric development as an aid to agriculture. 1926.
- U. S. D. A. Agriculture yearbook 1925.
- U. S. National Museum
Annual report of the Smithsonian Institution. 1905, 1907, 1914-1917, 1922-1923.
Proceedings, Vols. 52-53, 55-65.
- Von Noorden, C.
Clinical treatises on the pathology and therapy of disorders of metabolism and nutrition. Parts 2-9.
- Washington, George
Calendar of correspondence, Vols. III and IV (Index).
A calendar of Washington manuscripts in the Library of Congress. 1901.
List of Washington manuscripts 1592-1775.
Papers of George Washington I, correspondence with continental Congress. 1906.
Papers, No. 2, Vols. I (1775-1778) and II (1778-1780).
- Wiley, H. W.
Principles and practice of agricultural analysis. Vol. I (1926).

ERRATUM

The phrase "DISTRIBUTED charges," appearing on page 40 and in tables 2 and 8 in Pedro Paje's article, "The Cost of Raising Pullets under Conditions Existing in the College of Agriculture," which appeared in the June, 1927, number of THE PHILIPPINE AGRICULTURIST, should read "capital charges".



THE WORLD'S FARMERS GET TOGETHER

In an article under this caption in the *Review of Reviews*, March, 1927, Dr. Kenyon L. Butterfield, President, Michigan State College of Agriculture and Applied Science, after briefly summing up the aims of organizations, such as the International Commission on Country Life, American Country Life Association, International Conference on Agriculture, International Institute of Agriculture, International Plunkett Foundation, interprets these and similar organizations as part of the world-wide movement of farmers toward a "place in the sun," through co-operation. We quote Doctor Butterfield.

It is doubtful if people generally realize the importance of all of these endeavors. It must be remembered, however, that agriculture is not only the world's largest industry but that it is the most fundamental and vital. Until the time when the dim prophecies of science in the production of synthetic foods are realized, the farmers' contribution to society is a primary one.

Agriculture also involves the largest element of the world's population. Probably out of the billion and three-quarters of the people living in the world, at least one billion live and make their living on the land.

Again, the rural people of the world are rapidly coming into new power. This is perhaps best exemplified in Eastern Europe, where not only in Russia but all through the Balkans and in some other States, the peasants have virtual possession of the land that once belonged to great landlords. This new possession not only gives them great economic power but tremendous political prestige. Students of Russian history, for example, usually wind up by saying that, in the long run, the peasant will determine Russia's civilization and political policies.

The potential influence of the world's rural people in a controlled civilization is beyond imagination. If they have adequate intelligence and education, if they combine their forces nationally and internationally, they will have almost the decisive word with regard to national policies as well as concerning world co-operation and organization.

Furthermore, it is quite possible that we may develop a distinctive rural culture as a phase of advancing civilization. There are such things as a rural way of life, a rural mode of thought, and a specific rural community consciousness. If we can give to these local communities modern mechanical conveniences that reduce the severer aspects of toil, and keep the rural folk in touch with world influences through organization and continuing education, we may find that they will make a real contribution.

The influence of all of these international endeavors will be determined, in the long run, not merely by the significance of the industry of agriculture and of rural populations, but also by the importance which international co-operation is to play in the life of the world. There can be no doubt that the very existence of these international efforts in the rural field is an expression of a growing conviction of the importance and, indeed, of the absolute necessity of gaining the habit of international co-operation.

Agriculture is the great basic industry, says Dr. A. L. Dean, Director of the A. H. P. C. Experiment Station. If a nation is to prosper, its agriculture must be successful. Farming is not merely work, it is an enterprise. The day of the strong back and the weak head in agriculture has passed. To be successful in farming a man needs resourcefulness and the ability to work hard. Further than that, however, he needs knowledge of two kinds. First, he needs technical knowledge of agriculture, and second he needs business knowledge. No man can be a really successful farmer unless he can combine those two sorts of knowledge. The commonest shortcoming of farmers is lack of business sense and methods. They keep few or no accounts and have no real information on what operations are profitable and what ones are conducted at a loss. Every man who hopes to be successful on the land should get a good grounding in business methods and be familiar with the principles of accounting and of marketing.

—*The Extension Letter* (University of Hawaii).

... The poet's prayer, "Oh, wad some power the giftie gie us, to see oursels as ithers see us," was never more needed by any one than by the writer of bulletins. The man who can not write correct English does not see his ungrammatical constructions. The man who has a limited vocabulary does not realize the lack of clearness which results from his failure to use words carrying exactly the meaning or shade of meaning desired. The man whose style is verbose and redundant does not recognize the verbosity and redundancy of his writing. The man who is accustomed to long and complex sentences does not perceive the value of short, concise statements. Because he is unable to see the errors and faults of his work, he may be indifferent to suggestions of needed change, and resentful of changes made.

What is the remedy for the effect of these personal factors? Obviously, true perspective is the only remedy. The writer needs to stand off and study his product from new and different mental angles or viewpoints. First, he should put it away and let it get "cold". This may require ten days, or two weeks, or a month, depending on the person and on how completely he can forget it. At the end of this necessary period the writer can read his paper with something of the impersonal viewpoint from which others see it. Then only can he appreciably better it.—THE TECHNICAL BULLETIN, January, 1927.

—*Journal American Society of Agronomy.*

EDUCATION AND AGRICULTURAL PROMOTION IN JAPAN: IV. PROMOTION OF AGRICULTURE¹

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A discussion of the agriculture of Japan without mention of its relation to the population would be grossly incomplete and unbalanced. Nothing catches the eye of a traveler in Japan quicker than the density of the population and the intensive cultivation of the farm lands. This is especially true in the well-beaten tracks of travel in the central and southern parts of Japan. In the northern third of the main island, Honshu, and in the island of Hokkaido evidences of congestion are not so apparent.

The total area of Japan proper is 147,652 square miles, which compared with the 114,400 square miles of the Philippines, shows that Japan is larger by about 13 per cent. But, Japan proper has a population of about sixty millions (59,736,704 persons in October 1925) or five times as many as the estimated twelve million of the Philippines. A large area of Japan is very mountainous, however, and not easily available for cultivation even under the intensive system of hand tillage practiced in Japan, so that the productive area is comparatively small. It is estimated that the cultivated area is 6 million cho, roughly corresponding to 6 million hectares. According to Professor Shimizu, of Keio University, as quoted by the Japan Yearbook for 1926, which I shall follow closely in this discussion, the density of population per square kilometer of cultivated area in different European countries compared with Japan is as follows:

Spain.....	90	England.....	226
France.....	108	Holland.....	273
Switzerland.....	168	Italy.....	305
Germany.....	185	Belgium.....	394
Japan.....	969		

Japan stands far ahead of any European country, generally regarded as having a dense population. The present rate of increase in population is 1.3 per cent a year so that a greater load has to be carried by available resources from year to year. How this is met will be discussed presently.

The most generally raised crop of Japan is rice, this being the staple food of the people, and in going over the country one gets the impression that wherever rice will grow it is the crop planted. Of the total cultivated

¹General contribution from the College of Agriculture No. 187.

area, more than half is devoted to rice and practically all of this is in paddy fields, upland rice not being raised, generally. It is estimated that half of the food consumed in Japan is rice. Secondary crops are barley, beans, wheat, rye, sweet potatoes, vegetables, and fruit.

Barley is now widely used as food, especially by the farming class. It is mixed with rice and the mixture is claimed to be more digestible and less conducive to causing beri-beri than rice alone.

A concise summary of the value of other agricultural crops is given in the Japan Yearbook of 1926:

Among subsidiary farm crops there is perhaps nothing which plays so important a part in the Japanese kitchen as soy beans. The three daily articles of diet for all classes, viz., soy, miso and tofu are manufactured with this bean either in part or wholly. The "tofu" (bean curd) is one of the most popular articles of diet, being cheap and highly nutritious; the "miso" (a sort of macaroni) makes Japanese soup and is used in various other ways. The "soy" (a sauce) is indispensable in Japanese cooking. Then for extracting oils, as manure [fertilizer?], and food for horses beans are equally important. The supply being insufficient, a large quantity comes in from Manchuria and Korea. In Japan, Hokkaido is the principal center of production. Red beans, also very extensively produced in the northern island, are used for making confectionery. Peas and horse-beans, whether green or fully ripe, are cultivated as a second crop after rice and as a forerunner to rice, indigo, etc., on upland farms. Groundnuts (peanuts) are among the subsidiary farm produce that goes abroad, mostly to U. S. A. In Japan they are used by confectioners and also for pressing oil. Sweet potatoes occupy an important place as supplying a cheap substitute for rice for poorer folk, while the tubers are also used for making starch and some alcoholic drinks. Potatoes, first brought by the Dutch in 1589, remained comparatively neglected till about a few decades ago, when the importation of superior varieties drew the attention of farmers. The tubers go to Russian Siberia and Manila. The best potatoes come from Hokkaido.

INTENSIFICATION OF CULTURE

The farming population of Japan is estimated at $5\frac{1}{2}$ million families, and the hectareage under cultivation at 6 million. This makes an average farm holding of a little more than one hectare to a family, which is so small that it calls for the most intensive type of culture.

Culture in the thickly populated localities near cities is done absolutely by human labor, although a farmer often has an ox to help him in plowing. In Hokkaido and northern Honshu, where the landholdings are larger, horses and American implements are extensively used.

Japan crops are heavily fertilized, especially with night soil, which is carefully stored and put back on the land. Of late years large quantities of commercial fertilizers have been imported to supplement natural manures. Other fertilizers used are compost, barnyard manure, fish guano, wood ash, and rice bran.

LAND RECLAMATION

It is estimated that there is still in Japan about two million hectares of land that could be reclaimed for tillage, and, by a rough estimate half of this could be converted into rice fields. The Government has embarked on

a program of reclaiming this land by reimbursing to the farmers 40 per cent of the cost of reclamation of areas of, at least, five hectares in size. If all this waste land were brought under cultivation, it is calculated that the food supply would be increased by 50 per cent.

LAND ADJUSTMENT

The Government has also undertaken the increase of acreage by adjusting the division of present farms, and enlarging the size of fields through elimination of unproductive boundary lines, such as dikes, mainly through consolidation by exchange of the land holdings of individuals situated in different localities. A force of experts is employed to carry this work of consolidation. Also, through this method a more rational division of the fields is made for purposes of irrigation and drainage. It is estimated that through this procedure there is effected an increase of 15 per cent in the yield of the same area of land.

The actual results brought about by the land reclamation and land adjustment systems have meant an increase of thirty thousand hectares of cultivated land in one year.

To further augment the acreage devoted to intensive cultivation, the Imperial family has decided to relinquish a number of its large estates in several regions, especially Hokkaido. These are cut up into small farms and sold to the people.

PRICE REGULATION

Japan realizes the dangers of possible famine attendant upon its insular location and protects itself by insuring the food supply of the nation. In order that the staple food of the country may continue to be grown in quantities closely approximating the needs of the country, the rice crop is protected as far as possible from the fluctuations of supply and demand. To this effect an act was passed in 1921 which aims to regulate the price of rice. Briefly, the working of the law is as follows: Whenever the price of rice tends to go below such a level as to make its production uneconomical, the government enters the market at a reasonable price and thus restores quotations to normalcy. Whenever the price tends to go up so as to threaten to disturb normal living conditions, the government opens up its stores and sells at a price that will reduce current prices to a reasonable level once more. The government has established granaries in four centers of population, in Tokyo, Osaka, Sakata, and Moji, with capacities ranging from 120,000 to 720,000 cavans.

The rice trade is to a large extent government controlled. Estimates are made of the incoming rice crop and this is balanced against the probable consumption. As the local production has not been equal to the demand since 1893 the difference is made up by importation, both from Japan's colonies, principally Korea and Formosa, and from abroad, French Indo-

China and Siam. The government aims to keep at all times a reserve for emergencies which it carries over from year to year.

A duty amounting to approximately one peso per cavan of clean rice is levied on imported rice.

RICE CONSERVATION

Japanese rice is much more palatable than the common rices. It partakes of many of the good features of glutinous rice without its defects. When cooked, it is soft but not sticky, it is savory and easily digested. Japanese are very fond of their rice and in Japan they pay about fifty per cent more for it than for the imported. Prosperous Japanese residing abroad import rice from Japan, paying a high price for it. The decrease in the local supply is made up by importation of cheaper kinds.

A considerable amount of rice is used in making *sake*, the common wine of Japan. It is estimated that about as much rice is made into *sake* as is imported from foreign countries, not including Japan's own colonies. The government is encouraging the production of this beverage out of materials other than rice. Investigators are working on possible substitutes. Should this move prove successful and the results of investigations be carried out in practice, it would release local rice in such quantities as to make further importation from foreign countries unnecessary.

AGRICULTURAL EXPERIMENT STATIONS

The agricultural development of Japan has received a decided impetus with the help of its experiment stations. The Central Experiment Station was first organized in 1890 as an experimental farm of the Department of Agriculture. Its field was the study of fundamental agricultural problems. Six branch stations were established in different regions to serve local agriculture. These were later abolished with the organization of prefectural experiment stations in the different prefectures, geographical units corresponding to our provinces. The Imperial Agricultural Experiment Station, while not organically at the head of the prefectural stations, maintains leadership over them through its central organization, more generalized field, better equipment and support, and personnel.

Probably the most important accomplishment of the stations has been the development of rice varieties well adapted to different sections of the country. These were largely tested and propagated in the prefectural experiment stations and distributed to their constituents. A similar line of work has been followed with other crops, but nowhere near so fully as with rice. In many instances new crops have been established in regions

through the agency of the local experiment stations. The exact working of the organization is succinctly described by Cramer²:

The central organization is run by the government. It consists of a division of the Central Experiment Station in Tokyo with several branch stations in various regions of Japan; . . . In these central stations the work comprises the selection and further breeding of pure lines out of well known varieties; crossing and further breeding of hybrids; the attention is especially concentrated upon the making of new types and the first testing of them from a practical point of view. Before a new race is sent out, it is tested by this central organization during 3 years, to determine its value for practical agriculture. Formerly it used to be even 5 years, but it has been found not necessary to carry on the testing for such a long period. After this preliminary testing the seeds are handed over to the prefectural stations; . . . In the last mentioned stations the staff not only tests out the forms received from the central organization, but also it isolates, crosses, and purifies its own forms. The prefectural stations send out the rice seeds to the multiplication fields of the townships where the forms are further tested and from where they pass over into the hands of the common farmer. Till this last distribution all the seeds are distributed free of charge. It is estimated that, at present, 70 per cent of the seeds used reach the farmer by the way sketched above.

Next to the geographic extension of the rice growing regions of Japan and the improvement of plant stocks through scientific breeding methods, probably the most important work of the stations has been in the study of the manurial requirements of different crops, especially rice. Practically all important crops are fertilized, and the use of green manures has been generalized largely through the teachings of the experiment stations. In the past, only natural manures were used, but now larger and larger quantities of artificial fertilizers are employed. As the use of artificial fertilizers, being now relatively cheaper than commercial natural fertilizers, becomes more generalized, the experiment stations act as mentors in their proper use. Kato, quoted by Cramer, estimates an average expenditure for fertilizers, natural and artificial, in Japan as approximately 100 yen a hectare in 1923.

The experiment stations have also been instrumental in the improvement of native fruits and the introduction and acclimatization of new fruits and vegetables, as well as in the development of improved cultural methods including irrigation and drainage. The most conspicuous examples of introduced fruits now widely grown and in commercial quantities are apples and grapes.

FARM ANIMALS

The subject of farm animals, not being an intrinsic part of Japanese agriculture, can be discussed separately and will form the subject of the next article of this series.

²Cramer, P. J. S. 1926. Notes on Agriculture in Japan. Communications of the General Experiment Station for Agriculture No. 22, Buitenzorg, Java.

MAÑGABOL FISHERIES OF BAYAMBANG, PANGASINAN¹

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Of the Department of Agronomy

WITH ONE GRAPH

No other municipality in the province of Pangasinan derives so much wealth from fisheries as does Bayambang. The municipality sets aside yearly, largely from income from fisheries, the sum of ₱25,000 for the local normal school and about ₱5,000 for the elementary schools. The fishing industry has made it possible for this town to be one of the most important educational centers of the province.

As far back as the revolutionary period (1899–1901), these fisheries played an important part in supplying fish to the soldiers of General Aguinaldo when they camped temporarily in Bayambang in their flight from the American Army². The American Army stationed for several years at Bayambang after the insurrection was supplied with fish taken largely from the Mañgabol fisheries.

Among the important points considered in the present survey are:

(a) How much income is derived yearly by the municipality of Bayambang from its fisheries. (b) How the income from the fisheries compares with the income from all other sources. (c) What part of the income is set aside for schools. (d) Is the supply of fish in the fisheries becoming depleted? If so, what are the possible causes and remedies?

THE FISHERIES

Location

The fisheries are located in Lake Mañgabol which is in the southern part of Pangasinan. The lake extends over a portion of a marshy stretch of land in the southern part of Bayambang Municipality. According to the map of the Coast and Geodetic Survey, Manila, the region is situated

¹ Experiment Station contribution No. 450. Received for publication, March 22, 1927.

² VILLA, SIMEON A. The flight and wanderings of Emilio Aguinaldo from his abandonment of Bayambang until his capture at Palanan. *Translated by J. C. Hixson in Philippine Education*, 13: 1926.

at about 15° 46' north latitude. The marshy land and its vicinity is about 130 square kilometers in area, and is entirely inundated periodically by the Agno River. The fisheries can be reached on foot in about three hours by following the rough path along the Agno River bank from Bayambang southward.

History of the ownership of the fisheries

According to Mr. Rufino Tagulao, Municipal Secretary of Bayambang, the vicinity of Lake Mañabol was a forbidding wilderness during the Spanish régime. It was inhabited by wild animals, such as deer, feral carabaos, monkeys, wild hogs, jungle fowls and other birds. Due to unrestricted hunting some of these species of animals have since disappeared. The writer saw a few monkeys and terrestrial and aquatic birds on his last visit.

The fisheries, according to Mr. Tagulao, were of no great importance prior to American occupation. This statement is probably true since the population at the time was small. These fisheries were the property of the central government (Insular Government) and were leased to Chinese fishermen. The products were marketed in Manila. On the establishment of Civil Government (1901) the ownership of the fisheries was transferred to the municipality of Bayambang. By this authority they were leased to private individuals, mostly Filipinos. The administration was rather lax and poor.

About 1912 the municipality declared the lake "Public Fisheries". It was then divided into lots and leased at public auction.

REVENUE DERIVED FROM THE FISHERIES

The population (1918 Census) of Bayambang is only about 15,000. However, according to the Executive Bureau, Manila, Bayambang has an annual income of ₱57,230.25 and is therefore a first class municipality. Of this income, ₱42,539.96 (average for a six-year period) or about 70 per cent of the gross revenue is derived from fisheries (table 1). Maximum

production was obtained in 1922 and 1923, but since then the income from these fisheries seems to be steadily declining (table 1 and graph).

TABLE 1

Yearly income from fisheries and gross income in Bayambang, Pangasinan

NAME OF FISHERY LOTS	INCOME FROM FISHERIES					
	1920	1921	1922	1923	1924	1925
	<i>pesos</i>	<i>pesos</i>	<i>pesos</i>	<i>pesos</i>	<i>pesos</i>	<i>pesos</i>
1. Banaoang na dueg...	9503.51	9503.51	13000.10	13000.10	8250.00	0.00
2. Manazan.....	6350.00	6350.00	13000.10	13000.10	8250.00	8250.00
3. Tubor.....	5440.00	5440.00	7250.04	7250.04	6000.00	6000.00
4. Mayor.....	3150.00	3150.00	8160.00	8160.00	6400.40	6400.00
5. Lepsag na Ilang....	2944.50	2944.50	5102.50	5102.50	4602.25	4602.25
6. Mabalbalino.....	700.10	700.10	1350.05	1350.05	854.00	854.00
7. Amañgonan.....	290.00	290.00	405.05	405.05	850.25	850.25
8. Nagsaang.....	610.00	610.00	495.40	495.40	664.00	664.00
9. Nasiban.....	449.08	449.08	850.00	850.00	500.00	500.00
10. Buelañg.....	457.80	457.80	602.00	602.00	702.50	702.50
11. Apalintogan.....	696.00	696.00	—	—	1250.00	1250.00
12. Tanoloñg.....	202.50	202.50	352.50	352.50	800.35	800.35
13. Maibpa.....	262.50	262.50	408.30	408.30	650.00	650.00
14. Anlañgigan.....	—	—	625.00	625.00	750.00	750.00
15. Buri Palms.....	260.00	260.00	212.54	212.54	301.12	301.12
16. Manamboñg.....	407.05	407.05	—	—	—	—
17. Pao.....	360.00	360.00	662.53	662.53	251.10	251.10
18. Talinoroñg.....	200.00	200.00	—	38.25	190.00	190.00
19. Camboca.....	101.00	101.00	101.50	101.50	241.10	241.10
20. Malimpee.....	162.50	162.50	—	—	—	—
21. Tococ.....	185.00	185.00	—	—	62.50	62.50
22. Ataynan.....	220.20	220.20	44.04	44.04	—	—
23. Bincoan Amamoan..	38.25	38.25	—	—	—	—
24. Lubir.....	—	20.00	67.50	67.50	79.00	79.00
25. Malimpee Dilay Vaca	—	—	—	21.05	85.00	85.00
26. Banaoang na Pasin..	275.00	225.00	367.52	367.52	450.00	450.00
27. Langiran.....	—	—	—	—	—	—
1. Total income from fisheries.....	32364.99	32334.99	53056.67	53115.97	42183.57	42183.57
2. Income from other sources.....	14313.31	19687.44	18365.09	16189.20	15665.19	31853.36
Total from all.....	46678.20	52022.43	71241.76	69305.17	57848.76	74036.93

Sources of School Fund

It is believed that all of the funds needed for the support of the schools in Bayambang could be provided by fishery revenues. According to Mr. Edward Murphy, Division Superintendent of Schools for Pangasinan, Bayambang, through its Municipal Council, has obliged itself to set aside yearly the sum of ₱25,000 for the Bayambang Normal School and its train-

ing department. This sum does not include the amount needed for the maintenance of the elementary schools which runs to about ₱16,000 yearly. The total appropriation for schools in Bayambang during the school year 1926-1927 was ₱42,999. On the average, for a six-year period, since the time the municipality received considerable income from its fisheries, about 42 per cent of the total revenue or about 60 per cent of the income from fish has been devoted to schools. The graph shows the annual income of the municipality from fish as compared with that from other sources. It also shows the yearly expenses of the municipality for schools.

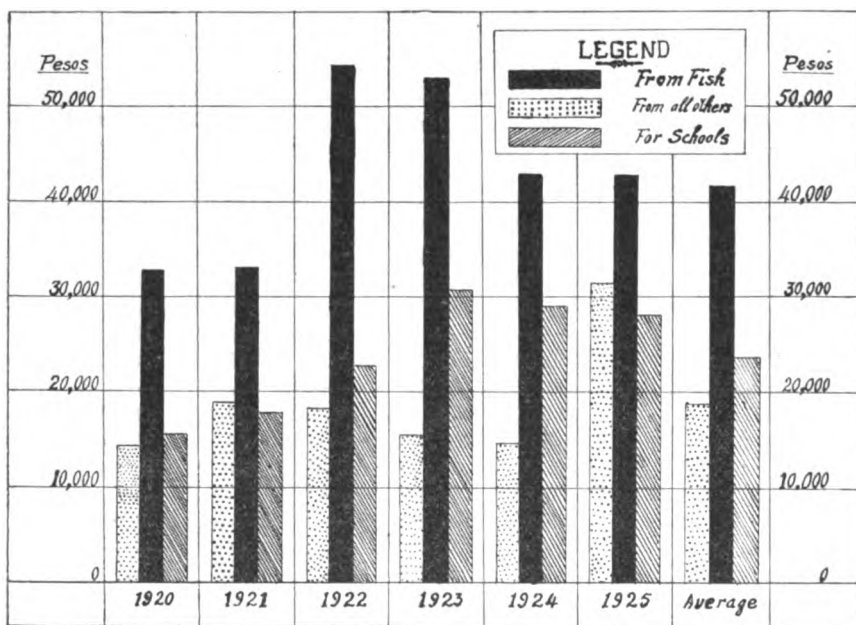


FIG. 1.—Income from fish and other sources and expenses for schools in Bayambang, Pangasinan.

MANAGEMENT OF THE FISHERIES

The fishery lots and their sale

Lake Mañabol is divided into twenty-seven lots. Five of the most important of these lots had the following average income for a period of six years: (1) Banaoang na Dueg ₱10,417.88; (2) Mananzan ₱9,283.33; (3) Tubor ₱5,930.00; (4) Mayor ₱5,903.00; and (5) Lepsag na Ilang ₱4,049.25, or a total of ₱35,583.89. The remaining lots contributed for the same period of time an annual total average of ₱7,209.98.

All of these lots are leased for a period of two years to private individuals. One lessee may occupy one or more lots at a time.

Fishing

The most common method of fishing in use throughout the year is by ordinary traps such as *tuel*, *pasabing*, *sicop* and other primitive means. Hook and line are used to a very limited extent. During the dry season, when the fish are caught primarily for market, fishing nets and some improved fish traps like the *talakeb* are used extensively.

During the dry season, which commences in November and ends in May, the water of the lake becomes shallow and many parts of the marsh dry up. Naturally, the fish move to the brooks and to other parts where the water remains deep. Here they gather in large numbers and then are led further down streams into the reservoirs, *bonoan*, which are inclosed by corrals. The number of fish collected in these *bonoans* is sometimes so great that one can easily catch fish barehanded. At this time the *bonoan* is said to "break" and is then ready for fishing.

When the day for fishing has been decided upon by the lessee, he invites, by distributing printed slips and posting placards in conspicuous places, the people in the nearby towns, Bautista, Malasiqui, San Carlos, Urbistondo and Camiling, to come and fish. Sometimes an agent or two are employed to carry out the advertisement from town to town so that many people will come to fish.

The day set for fishing is a big day for the lessee of the lot. From five to ten thousand people of both sexes and different ages come to fish, if the lot happens to be an important one. Every member of the fishing parties is assessed a certain fee and this constitutes at this time the only income of the lessee.

Fees and methods of fishing

The lot to be fished is previously subdivided into smaller lots each of which should be fished according to the lessee's instructions. There are special lots that are for groups of women and children. A lot is given a group of men with fishing nets or with fish traps, *talakeb*, and the members of this group are usually charged a fee of from one to two pesos each. Those who fish barehanded are usually charged from twenty centavos to one peso each, while children pay ten cents each. The whole day is devoted to fishing and each may catch as many as he can carry home.

After the first fishing, the lot is allowed to rest for some time to give the fish a chance to increase undisturbed. A lot may be fished as often as from two to three times during the season depending upon the supply of fish.

Quantity of fish caught

It has been estimated by Mr. Tagulao that the fish caught annually value not less than ₱100,000. Considering the amount paid into the treasury from the fisheries alone to be about ₱40,000, there is every reason to believe that the estimate is a fair one. It would require careful account-

ing and a very thorough survey to determine accurately the quantity and value of the yearly catch from the lake.

The most numerous fishes found in the lake are dalag, *Ophiocephalus striatus* Bloch; pantat (hito), *Clarias batrachus* (Bloch); and alalo (liwalo), *Anabas testudineus*. Semi-fresh water fishes are also found, among the most common are aliso or banak, *Mugil cephalus* Linn., and bolan-bolan, or buan-buan, *Megalops cyprinoides* Broussonet. Shrimps are also caught in large quantities during certain parts of the year. There are, according to the fishermen, about fourteen species of fish that are caught on a commercial scale in the lake.

Marketing

A great portion of the fish caught in the lake is sent to Manila (1918 Census), Tarlac and Pampanga markets, *via* the Manila Railroad. Bamboo baskets are used as containers. These are so well built that water does not leak out.

The nearby municipalities of Bautista, Malasiqui and San Carlos, also on the railroad line, are supplied with fish from the lake. Camiling, a town of Tarlac and south of Bayambang, is also supplied from these fisheries.

Added to these markets, there is the local market with several hundred students of the normal school to make local consumption of fish from the lake large.

POSSIBLE CAUSES OF DECREASE IN FISH SUPPLY

In the course of the survey, the following apparent causes for depletion of fisheries were found.

The fisheries are neglected. To quote the Municipal Treasurer: "The municipality does not spend anything on the lake for it is always rented by private persons who may in case of necessity spend something for improvement." Naturally, under this condition even the path to the fisheries is very poor and marketing fish involves much expense, consequently the prices are high.

The fishermen do not seem to co-operate in conserving the fish supply. Fish of any size are caught in any quantity and in any season, so that the very young fish and the mother fish are included indiscriminately in each haul. It is not strange then that the supply is steadily decreasing. Old men of the town frequently remark on this deplorable condition and practice.

The decrease in the fish supply is also attributed by the people to the effect of growing tobacco in the vicinity of the fisheries. The nicotine content of the stems left in the field after harvest leaches off into the water and affects the fish.

It is claimed that the periodical inundation of the lake by the Agno River causes the depletion of the fish supply of the fisheries. The effect

was indeed very deplorable in 1924 when the river cut a new course direct to the lake from Bautista. Now that a dike has been built across this new course extending along the southern bank of the river the danger from the overflow has been reduced.

A remedy for the situation

It is suggested that the municipal council or other body in authority should take immediate steps to remedy the situation.

To introduce additional species of fishes into the lake may prove profitable. Dr. A. W. Herre, of the Division of Fisheries of the Bureau of Science, has suggested that carp, *Cyprinus carpio* Linn., may be used for this purpose. The species has been found successful in stocking Laguna de Bay. The following is an item on this from one of the Manila daily papers:

Carp fish, which originally came from Canton, China, is now abundant in Laguna Bay, particularly in waters near Santa Cruz and Los Baños, according to the Bureau of Science. The fish cost ₱5 a piece.

According to Director Brown of the Bureau of Science, several carp fish were brought from Canton two years ago to the Bureau for experiment. They were let loose last year in Laguna Bay for breeding. Dr. Herre, chief of the fishery division of the Bureau, went to Laguna Tuesday and found that large number is being caught every day.

To stock Lake Mañgabol with carp, according to Dr. Herre, it is necessary that the municipality of Bayambang should defray the cost of fish used. The amount is not much considering the possible increase in the value of the fish supply of the lake when this project is accomplished.

SUMMARY

- (1) The greatest resource of Bayambang are the Mañgabol fisheries which yield about ₱42,000 yearly or over 70 per cent of the total revenue.
- (2) About 60 per cent of the income from fisheries is devoted to schools. This is about 42 per cent of the total revenue.
- (3) The income from fish is steadily decreasing, probably due to unrestricted fishing employed by the private lessee of the fisheries of the lake.
- (4) Protective measures in fishing and the introduction of carp into the lake may help improve the condition of the fisheries and their fish supply.

ACKNOWLEDGEMENT

The writer is greatly indebted to Dr. L. B. Uichanco of the College of Agriculture for his valuable suggestions and help in putting this paper in shape; to Dr. Herre of the Bureau of Science for suggestions and to his former students in biology in the Bayambang Normal School for their help in gathering some data.

COST OF RAISING PIGS FROM THE TIME SOWS ARE BRED UNTIL THE PIGS ARE WEANED¹

VICTOR T. FELICIANO

The object of this experiment was to determine the cost of raising pigs from the time sows are bred until the pigs are weaned.

The work was begun in July, 1923, and ended in January, 1925, a period covering one year and six months. It was carried out in the Department of Animal Husbandry, College of Agriculture, Los Baños.

MATERIALS AND METHOD

Animals

There were seventeen sows used in this experiment, but of these only five completed the full period of observation. These five sows bear herd numbers 7, 207, 208, 210, and 309. Sow 210 farrowed twice, making 6 litters in all. In the tables this second litter is designated as "Sow 210A." Sow No. 309 is a native and happened to be the mother of sows Nos. 207, 208, and 210. These were Berkshire grades. There is no record as to the exact age of sow No. 309. Sows Nos. 207, 208, and 210 are sisters and were about three years and six months old when the experiment began. Sow No. 7 is the daughter of sow No. 208, and was two years and six months old. The sows were poor in condition when the experiment was begun. They were bred to a pure-breed Berkshire boar, so all the pigs used in the experiment had at least 50 per cent Berkshire blood.

Land and equipment

The area of land used in this experiment was approximately 5157 square meters. This area was divided into four different lots. Lot I had an area of 1787 square meters, was triangular in shape, and had no vegetation except some trees and bamboo which served as the natural shade and shelter of the animals placed in it. Lots II, III, and IV had an area of 1280 square meters, 1440 square meters, and 650 square meters respectively. These lots were planted with camote (*Ipomoea batatas* Linn.) and used as pasture for the animals. The number kept in each of the lots varied, owing to the difference in the time of farrowing of the sows. The topography of the land is hilly. Three compartments of the hog house; three troughs; two balances; and one empty cement barrel were used in this experiment.

¹Thesis presented for graduation, 1925, with the degree of Bachelor of Agriculture, College of Agriculture, No. 251; Experiment Station contribution No. 451. Prepared in the Department of Animal Husbandry under the direction of Dr. B. M. Gonzalez.

Feeds and minerals

The feeds that were used were corn, copra meal, rice bran, and camotes. The camote was planted in lots II, III, and IV. Most of the corn used was raised in the Department of Animal Husbandry. The copra meal was bought from Oriental Oil Co., and Copra Milling Company in Manila. This copra meal was low in fat content. The rice bran used was bought in Sta. Rosa, Calauan, and Cabuyao and was of fair quality. Charcoal from wood and corn cobs and salt were given and also a mineral mixture.

Care and management

From the beginning of the experiment, sows which were bred were placed in lot I. The sows were kept there until well advanced in pregnancy. Besides the regular feed the sows were given every day fresh camote leaves gathered from lots II, III, and IV. The animals were supplied with clean fresh water all the time. They were also given charcoal and common salt once a week. Five to ten days before the animals were supposed to farrow, they were placed in a farrowing pen which had been prepared, cleaned, and disinfected. The sows were provided with clean bedding of dried banana leaves or excelsior, and clean troughs. The quarters were cleaned every day and disinfected with creolin solution once a week. In the farrowing pen the sows were also given camote vines and charcoal. Paddocks adjoined the farrowing pens. One or two weeks after they farrowed, when the small pigs were strong enough to run with the mother, they were put into one of the camote pasture fields. When the weather was bad the pigs were driven into the hog house.

When the pigs became more or less independent of the mother, they were weaned gradually. As soon as complete weaning was accomplished both the mother and the small pigs were weighed and turned back to the department.

During the progress of the experiment the animals were infested with lice most of the time. The infested sows were sprayed with a strong solution of creolin. The small pigs were bathed individually with 5 per cent creolin solution, and then a mixture of one part coconut oil and two parts kerosene was rubbed over the surface of the body with a piece of rag. This was found to be very effective.

Manner of feeding

The animals were fed twice a day. They were given a definite amount of the feed mixture each feeding. This was given in the form of thin slop. The amount given was as much as they could clean up in 10 to 15 minutes. Two to three sows were allowed to each trough.

The ration consisted of one part corn, two parts copra meal, and three parts rice bran by weight. The nutritive ratio of this ration is 1 : 6.28.

During the summer when the camote pasture in the three lots was almost exhausted the animals were given minerals mixed with their feeds, besides the charcoal and common salt which was given once a week. The formula of this mixture was as follows:

Bone black.....	10 grams
Sodium sulfate.....	10 "
Sulfur.....	5 "
Iron sulfate.....	5 "
Common salt.....	5 "
Potassium iodide.....	32.5 "
Powdered wood charcoal.....	32.5 "
Total.....	100.0 grams

This was added to every fifty kilograms of the mixed feed.

The animals were weighed once a week to determine the rate of growth. The initial weights of the sows were taken within twelve hours after they were bred. When the sows farrowed the mothers and the newly-born pigs were weighed within twenty-four hours. When the litters were completely weaned their final weights were also taken.

As the purpose of the experiment was to compute the cost of production, all work in connection with the animals was recorded. The cost of the feed consumed; the depreciation of the equipment used; and the rent of the sows and their depreciation; the rent of land, etc., were calculated on the basis of the average current price during the time of the experiment in a manner similar to Peña's² calculations.

The loss in weight of the sows was charged off at ₱0.60 per kilogram live weight and this was deducted from the income.

EXPERIMENT AND RESULTS

Experiment

Labor cost. The labor cost in this experiment was based on the wages of the hog man working in the department, who received ₱1.20 a day for ten working hours. The labor on the experiment was approximately one hour a day and the experiment lasted 561 days. The cost of labor was, therefore, ₱67.32.

Feed cost. The average current price for a kilogram of feeds, from July, 1923, to January, 1925, was: ₱0.079 for corn; ₱0.047 for copra meal; and ₱0.064 for rice bran.

Depreciation of the sows. As a general rule, sows lose in weight during the suckling period, hence the decrease in weight of the sows, as shown in table 1, was charged against the pigs at the prevailing price of pork in the College, which was ₱0.60 a kilogram live weight.

² Peña, Daniel B. 1924. The cost of raising swine under existing conditions in the College of Agriculture. The Philippine Agriculturist 12: 469-480.

Land and house. The rent of the land was charged against the income. The rate of rent was 12 per cent per annum on the total value of the land used. The value of one hectare was ₱150.

The rent of the house was figured at ₱3 per annum for every compartment. The house was used very little, only for about three weeks at each farrowing.

Observations

The pastures of the Poultry-Swine Station of the Department were badly infested with kidney worms, ascaris, and lice. These parasites gave much trouble both to the animals and to the attendant. Many of the sows which we tried to use in this experiment did not catch the service of the boar.

Six litters out of five sows are included in these observations. The number of pigs born was 56, or an average of 9.3 pigs a litter. Fifteen pigs died before weaning, showing a weighted average mortality of 26.8 per cent. The number of pigs raised per litter was, therefore, 6.8 pigs. (See table 2.)

In general, the sows were not good breeders. The average birth weight of their young was .71 kilogram, which may be considered low. According to the records of Peña¹ the average birth weight of grade pigs in the College varies from 0.8 to 1.0 kilogram.

The pigs were weaned when between eleven and sixteen weeks of age. Their average weight then was 6.5 kilograms. The growth of the pigs was slow. This may have been due to the parasitic infestation of the animals (see table 3). The boar used in this experiment was quite advanced in age and this may have been partly the cause of the low fertility of the sows.

Results

Accounts. The expenditures may be summarized as follows:

Land, building, fences, and equipment:

Rent of .515 hectare land (value ₱77.35) for 1½ years at 12 per cent per annum.....	₱13.92
Rent of 3 compartments of the hog house for 1½ years at ₱3.00 per annum..	13.50
Interest on 418 meters of fencing (value ₱292.60) for 1½ years at 12 per cent per annum.....	52.21
Depreciation at 5 per cent per annum.....	14.63
3 feeding troughs at ₱2.00.....	6.00
	₱100.26

Stock:

Interest on sows for 1½ years (value ₱251.70) at 12 per cent per annum....	₱45.30
Depreciation sows (31.5 kilograms) at ₱0.60 per kilogram.....	18.90
	₱64.20

¹Peña: *loc. cit.*

Feeds and drugs:

290.82 kilograms of corn at average price of ₱0.0795 per kilogram.....	₱23.12
581.64 kilograms of copra meal at average price of ₱0.047 per kilogram....	27.33
872.46 kilograms of rice bran at average price of ₱0.064 per kilogram.....	55.83
0.12 kilogram of bone black at ₱1.48 per kilogram.....	0.17
0.17 kilogram of sodium sulfate at ₱0.18 per kilogram.....	0.03
.08 kilogram of potassium iodide at ₱4.52 per kilogram.....	0.31
.085 kilogram of sulfur at ₱0.80 per kilogram.....	0.06
.08 kilogram of iron sulfate at ₱0.40 per kilogram.....	0.03
6 kilograms of common salt at ₱0.04 per kilogram.....	0.24
1 bottle of creoline.....	1.38
1 liter of coconut oil.....	0.80
1/3 can petroleum oil.....	0.70
	₱110.00

Labor:

Cost of general labor.....	₱ 67.32
Total expenses.....	₱341.78

Cost of each pig. Dividing the total expenditures, ₱341.78, by the number of pigs raised, 41, the cost for each pig was ₱8.34.

Cost of feeds for each pig. Dividing the total cost of feeds, ₱110.00, by the number of pigs raised, 41, the cost of feeds for each pig was ₱2.68.

DISCUSSION OF RESULTS*The cost of feed per pig*

The average cost per pig, when all expenses are included, was ₱8.34. Owing to the steady increase in the price of the feeding stuffs the cost of feeds per pig was quite high. Indirect factors affecting the high cost of feed was the poor harvest of 1924 and also the poor growth of the pigs.

Conditions affecting the cost of production

So far as the writer is able to estimate, other conditions affecting the cost of production are:

(1) A very large capital was invested in fencing, which was all charged to the six animals that farrowed and weaned their pigs within the period of observation. (2) The same was true for labor, supplies, etc., which were all charged against the sows that farrowed. (3) During the period of the experiment the price of feeds increased steadily. (4) The time of the experiment was prolonged owing to the shortage of materials, hence the cost of labor was increased considerably. (5) The fertility of the breeding animals used in the experiment was unusually low. (6) There was a high percentage of mortality caused by parasitic infestation, and the animals surviving had a stunted growth. All these conditions were not favorable to making a profit, and, on the whole, may be considered as abnormal.

According to the figures on table 2, it shows that the average gestation period of the sows was 114.6 days which is considered normal, and the average lactation period was 89.2 days or almost 13 weeks. Average grain

feed consumed by each sow during the gestation period was 130 kilograms and during the lactation period 164.9 kilograms for the sow and pigs.

The cost of the above was ₱8.25 for the gestation and ₱10.45 for the lactation period. (See table 4.)

SUMMARY

1. Under the existing conditions in the College of Agriculture when this experiment was carried out in the Poultry Swine Station the cost of feed per pig from the time the sows were bred until the pigs were weaned was ₱2.60.

2. It was found that the average cost of raising a pig to weaning when all expenses are taken into account was ₱8.34.

3. The average weight of the pigs at weaning age being 6.5 kilograms, the cost of producing a kilogram weight is therefore ₱1.28.

4. It was found that the average grain feed consumed by one sow during the gestation period was 130 kilograms, and during the lactation period, 164.91 kilograms. This includes the feed consumed by the suckling pigs.

5. Basing calculation on the current price of feeding stuffs used in this experiment, the average cost of feed consumed by a sow during gestation period was ₱8.25 and during lactation period ₱10.45.

TABLE 1
Showing weight of sows

SOWS	No. 7	No. 207	No. 208	No. 210	No. 309	No. 210	TOTAL WEIGHT
	kgm.	kgm.	kgm.	kgm.	kgm.	kgm.	kgm.
Initial weight.....	54.0	78.0	68.0	71.5	78.0	70.0	419.5
Weight after weaning.	52.0	73.0	65.0	60.0	71.0	67.0	388.0
Difference	2.0	5.0	3.0	11.5	7.0	3.0	31.5

TABLE 2
History of the litters

SOWS NO.	DATE MATED	DATE FARROWED	PERIOD OF GESTATION	NUMBER OF PIGS IN THE LITTER	NUMBER OF PIGS DEAD OR WEAK AT BIRTH	NUMBER OF PIGS REMAINING UP TO WEANING	PERCENTAGE PIGS BORN RAISED TO WEANING
7	July 19	Nov. 13	117	10	4	6	60.0
207	Jan. 18	May 14	117	8	1	7	87.5
208	Jan. 18	May 9	112	9	3	6	66.7
210	July 12	Nov. 3	114	12	3	9	75.0
309	Jan. 8	April 30	113	10	3	7	70.0
210A ^a	—	—	—	7	1	6	85.7
Total							
Average..	—	—	114.6	56	15	41	73.2

^a Second farrowing of Sow 210.

TABLE 3

Showing the cause of death of the pigs, as found on post-mortem examination ^a

HERD AND BIRTH NO. OF PIGS	REMARKS
10 B	Died of ascaris and kidney worms
11 B	Died of general weakness
8 B	Died of weakness
9 B	Crushed by mother
8 B	Died of ascaris and kidney worms
7 B	Disappeared, probably eaten by mother
93 H	Died of ascaris
107 H	Died of ascaris and kidney worms
109 H	Died of ascaris and kidney worms
112 H	Died of ascaris and kidney worms
115 H	Died of general weakness

^a Four other pigs were born dead and were not posted.

TABLE 4

Showing the cost of feeds consumed during gestation period and lactation

SOW NO.	LENGTH OF GESTATION PERIODS	TOTAL MINED FEED CONSUMED DURING GESTATION	COST OF FEED CONSUMED DURING GESTATION	LENGTH OF LACTATION PERIOD	TOTAL MINED FEED CONSUMED DURING LACTATION	COST OF FEEDS CONSUMED DURING LACTATION
	<i>days</i>	<i>kgm.</i>	<i>pesos</i>	<i>days</i>	<i>kgm.</i>	<i>pesos</i>
7	117	122.5	7.78	77	154.1	9.78
207	117	119.0	7.55	78	149.0	9.45
208	112	112.0	7.11	83	95.6	6.07
210	114	183.5	11.65	111	224.0	14.22
309	113	113.0	7.17	93	182.8	11.60
210A	—	—	—	93	184.0	11.58
Average...	114.6	130.0	8.25	89.2	164.9	10.45

TILLERING OF RICE¹

DIONISIO CALVO

Rice varieties differ in their tillering power; some varieties produce more tillers than others. While it is supposed that the tillering power is a hereditary character, its expression is greatly modified by some external factors and by treatments, among the most important of which are the rate of seeding, the time of transplanting, the method of planting, the distance of planting, and the treatment of the soil. Hence, a knowledge of the tillering habits of the different rice varieties and of the factors affecting tillering is very desirable.

REVIEW OF PAST WORK

A number of investigators have worked extensively on rice characters, in general, as affected by some controllable factors. A few have studied the tillering habits of some cereals, such as wheat, rye, corn, and barley as affected by the rate of seeding and distance of planting, but no detailed systematic study on this single character of rice has been made in the Philippines.

Parr (1912) stated that the extent of tillering of cereal crops is inversely proportional to the amount of seeds sown within certain limits. He also stated that, without taking into consideration the fertility of the soil, the quantity of space allowed to each plant is the limiting factor of the plant's power to produce tillers.

Londsdale (1909) reports that "rice possesses the property of throwing out new shoots (tillers) when planted singly, but which does not occur to any great extent when planted in bunches varying from two to twenty seedlings". He claims that due to this practice of planting in bunches, most varieties lose their power of tillering, but this can be regained if the seedlings are planted singly year after year.

Jacobson (1916), in his work on the correlative character of the rice plant, found that varieties tillering freely produce more to the hectare than those that do not; and that when rice is transplanted, tillering is regulated by the number of plants set in the hill. He also found that tillering of the individual plant is negatively correlated with the size of grain and the number of grains to the panicle of the plant. That is, improved tillering habits of a rice plant are accompanied by a decrease in number of grains to the panicle.

¹ Thesis presented for graduation, 1926, with the degree of Bachelor of Science in Agriculture from the College of Agriculture No. 252; Experiment Station contribution No. 452. Prepared in the Department of Agronomy under the direction of Dr. Toribio Vibar.

Optiz (1905), in his investigations on rooting and tillering of grains, reports that, in general, the most productive varieties tiller more than those producing smaller yields. He also reports that wider distancing had the effect of improving the tillering habits of the plant. In this contention, he is supported by Hector (1921) who in his report on the work of the Department of Agriculture, Bengal, asserts that spacing has a great influence on the number of tillers and the number of grains to the tiller produced by the plant. Rodrigo (1924), in his investigation on the effect of spacing on tillering, concluded that, "the space allowed to each plant up to at least 40 centimeters each way was a criterion of the tillering power of the plant". He further concluded that as the space between the hills was increased greater variability in the number of tillers occurred and the number of tillers to the square meter diminished.

Jack (1921), in his preliminary report on experiments with wet rice in Krian, claims that tillers produced to the plant vary directly according to the space allowed a plant in transplanting, up to a spacing limit of 45.75×45.75 centimeters. Wider spacing than this tends to produce too much vegetative growth. Jack also asserts that as the number of plants to the hill is increased from one to four there is a fairly systematic increase in the number of tillers to the hill.

This same investigator reports that plants on good soil, transplanted but once, produce only one-fourth as much as when transplanted and split three times. Summers (1921), in quoting Graham and Jack, attributes the increased tillering of the transplanted rice to the increase in growth of the sub-aërial portion which is stimulated by the root pruning effects of transplanting.

Summers also asserts that the number of days to maturity is not a criterion of the tillering power of the plant. The same results were obtained by Jacobson (1921) with varieties maturing in less than 100 days.

Tiden (1911) reported that the tillering power of a variety fluctuates in different seasons, but that differences between varieties in the same class are smaller than differences resulting from weather conditions, distancing, and other similar factors.

OBJECTS OF THE PRESENT WORK

The general object of the present work was to make a preliminary report on the variability in the tillering power of different lowland varieties. The specific objects were: (a) To study the variability in tillering habits of several lowland rice varieties grown under Los Baños conditions; (b) to compare the tillering power of directly planted rice (*bacal* method) and the transplanted rice; (c) to determine the effect of spacing on the tillering power of rice; (d) to determine the effect of rate of seeding on the tillering power of rice; (e) to determine the effect of the age of seedlings at transplanting on the tillering power of rice.

TIME AND PLACE OF THE PRESENT WORK

The investigation was conducted during the College year of 1925-26. The experiments were performed in the rice paddies behind the U. P. Sugar Mill of the College of Agriculture.

MATERIALS AND METHODS

Study of the tillering power of different lowland rice varieties grown under Los Baños conditions

Thirty-two lowland rice varieties were sown July 12, 1925, in seed beds prepared in the local way. August 20-26, when about five weeks old, the seedlings were transplanted to rice paddies previously divided into lots, each variety occupying one lot. The hills were spaced at about 25×25 centimeters and one seedling was set to the hill. About one month after transplanting, the paddies were weeded once. Just before harvest time, the number of tillers to a plant of 100 hills from each variety were counted. The results obtained were tabulated and are on file in the College of Agriculture.

A comparison of the tillering power of directly planted rice (bacal method) and the transplanted rice, using the same variety, Apostol

Seeds were sown in seed beds previously prepared in the local way. When about four weeks old the seedlings were transplanted to the rice paddies. The hills were set at 25×25 centimeters; one seedling was planted to each hill. At the time of transplanting, seeds were planted directly in an adjoining rice paddy, setting the hills at 25×25 centimeters and planting about three seeds to the hill. When the seedlings were about two weeks old, they were thinned out to one seedling to the hill. When about ready for harvesting, the tillers of 100 hills from both the field transplanted and the one planted direct were counted and tabulated. Table 7 gives the average number of tillers of 100 hills from each paddy and the distribution of these hills according to the number of tillers to the hill.

To determine the effect of spacing on the tillering power of rice

Seeds were sown in seed beds previously prepared in the local way. When about four weeks old they were transplanted to a rice paddy which had been divided into four lots. Table 1 shows the distance of planting

in each lot, the number of plants to the hill, and the number of hills to the square meter.

TABLE 1
Spacing the experimental plots

VARIETY USED	PLOT NUMBER	SPACING	NUMBER OF PLANTS PER HILL	NUMBER OF HILLS PER SQ. M.
		cm.		
Apostol	1	12.5×12.5	1	64
	2	25 ×25	1	16
	3	50 ×50	1	4
	4	20 ×20	3	25

At harvest time, the number of tillers of 100 hills from each lot were counted. Table 7 gives the average number of tillers of 100 hills from each lot and the distribution of these hills according to the number of tillers to the hill.

To determine the effect of rate of seeding on the tillering power of rice, Apostol variety

The same procedure as used in experiment 3 was followed, except, that instead of varying the distance between the hills, the number of seedlings to the hill was varied, from one to four, using a distance of 25×25 centimeters in all cases. This difference in procedure is shown by table 6.

To determine the effect of the age of seedlings at transplanting on the tillering power of rice, Apostol variety

Seeds were sown in seed beds every two weeks, as follows: August 29, September 12, 26, and October 10. On October 24, or two weeks after the last sowing, all the seedlings were transplanted to a rice paddy previously divided into four lots, each lot not less than 42 square meters. In lot 1, eight weeks old seedlings were transplanted; in lot 2, six weeks old seedlings; and so forth. At harvest time, similar countings as in experiment 3 were made. The results are given in table 9.

Care of the cultures

Throughout the entire culture period, the different plots were treated practically the same. The irrigation water was maintained during the whole growing season.

EXPERIMENT AND RESULTS

Tillering power of lowland rice varieties

Table 2 gives a summary of the tillering power of 32 lowland rice varieties (actual results are on file in the College of Agriculture). It shows the average number of tillers for the 32 varieties and the distribution of these

Comparison in the tillering power between directly planted and transplanted rice

Table 3 gives the average number of fruiting culms of 100 hills of the directly planted, and 100 hills of the transplanted rice, and the distribution of these hills according to the number of fruiting culms to the hill, as affected by the method of planting. It also includes the mean and probable error of the number of fruiting culms of each method of planting.

TABLE 3

Effect of the method of planting on tillering

NUMBER OF BEARING CULMS PER HILL	DIRECTLY PLANTED ^a	TRANSPLANTED ^a
2	1	
3	2	
4	19	3
5	22	3
6	18	7
7	17	16
8	9	15
9	5	14
10	3	6
11	1	10
12	1	6
13	1	6
14	1	3
15		5
16		4
17		0
18		2
19		
Mean and Probable error.....	6.18 ± 0.142	9.84 ± 0.227
Difference between the two means.....	3.66 ± 0.2675	

^a Using 25×25 centimeters spacing and one seedling to the hill.

Effect of spacing on tillering

Table 4 gives the distribution of the plants according to the number of fruiting culms of each plant as affected by the distance of planting. The average number of fruiting culms of 100 plants for each distance of planting, as well as their mean and probable error, are also given. The table shows

the effect of different spacing on the relative power of the plants to produce tillers.

TABLE 4

Showing the effect of spacing on the tillering power of rice

NUMBER OF BEARING CULMS PER HILL	12.5×12.5	25×25	50×50	C. METHOD
1				1
2	2			2
3	2	2	2	3
4	11	4	4	7
5	11	11	4	7
6	9	7	6	13
7	15	10	6	17
8	13	12	4	9
9	11	15	11	9
10	11	11	6	5
11	7	6	10	6
12	2	9	9	6
13	5	3	10	2
14	0	3	5	1
15	1	2	7	2
16		1	2	2
17		1	4	1
18		2	3	1
19		1	3	1
20			3	2
21			1	1
22				1
23				1
Mean and P. E.	7.62±0.1856	9.03±0.2067	11.26±0.2913	8.77±0.3058

Table 5 is a summary of tables 1 and 4. The number of fruiting culms to the square meter was computed by multiplying the actual number of fruiting culms to the hill by the number of hills to the square meter under the different spacings.

TABLE 5

Computed number of fruiting culms per square meter as affected by the distance of planting

SPACING OF HILLS	ACTUAL NUMBER OF TILLERS PER HILL	COMPUTED NUM- BER OF FRUITING CULMS IN ONE SQ. M.
cm.		
20×20 ^a	8.77	219.25
12.5×12.5 ^b	7.62	487.68
25×25 ^b	9.03	144.48
50×50 ^b	11.26	45.04

^aThree plants to the hill.

^bOne plant to the hill.

Effect of rate of seeding on tillering

The influence of the rate of seeding on the tillering power of the plant is shown in table 7. This table gives the distribution of the hills according to the effect of the number of the seedlings planted to the hill on the power of the plant to produce tillers. The table also includes the mean and the probable error of each rate of seeding. Table 8 is a summary of tables 6 and 7. The number of fruiting culms to the plant was computed by dividing the actual number of tillers to the hill by the number of seedlings to the hill. The number of fruiting culms to the square meter was computed from the number of tillers to the hill and the number of hills in one square meter.

TABLE 6
Seeding the experimental plots

VARIETY USED	PLOT NUMBER	SPACING	NUMBER OF PLANTS PER HILL	NUMBER OF PLANTS PER SQ. M.
Apostol	1	25×25	1	16
	2	25×25	2	32
	3	25×25	3	48
	4	25×25	4	64

TABLE 7
Effect of rate of seeding on tillering

NUMBER OF BEARING CULMS PER HILL	1 PER HILL	2 PER HILL	3 PER HILL	4 PER HILL
2	2			
3	2	1	2	
4	5	2	1	1
5	6	6	2	2
6	11	7	3	3
7	9	7	7	8
8	16	9	7	7
9	8	9	6	6
10	9	8	9	7
11	6	15	17	5
12	7	6	11	10
13	5	7	8	14
14	5	6	6	6
15	2	7	7	8
16	3	3	3	5
17	1	3	2	2
18	1	1	1	2
19	1	1	2	4
20	0	2	2	3
21	1		1	1
22			1	1
23			2	1
24				1
25				2
26				1
Mean and Probable error	9.17 ±0.256	10.48 ±0.254	11.66 ±0.246	12.81 ±0.3251

TABLE 8

Computed number of fruiting culms per plant and per square meter as affected by the rate of seeding

RATE OF SEEDING	ACTUAL NUMBER OF TILLERS PER HILL	RELATIVE	COMPUTED NUMBER OF TILLERS PER PLANT	RELATIVE	COMPUTED NUMBER OF TILLERS PER SQ. M.
<i>plants</i>					
1	9.17	100	9.17	100	146.72
2	10.48	114.28	5.24	57.14	167.68
3	11.66	127.15	3.88	42.31	186.56
4	12.81	139.69	3.20	34.89	204.96

Effect of age of seedlings at transplanting on tillering

Table 9 shows the effect on tillering of age of seedlings at transplanting. The mean and the probable error of the number of fruiting culms in a hill for the different times of planting are also in the table. The data show the effect of age of seedlings at transplanting on the relative tillering power of the plants.

TABLE 9

Effect of age of seedlings at transplanting on tillering

NUMBER OF BEARING CULMS PER HILL	8 WEEKS OLD	6 WEEKS OLD	4 WEEKS OLD	2 WEEKS OLD
1				
2				1
3				2
4	2	1	3	7
5	3	2	3	16
6	4	3	7	16
7	7	8	16	16
8	12	7	15	6
9	10	8	14	8
10	14	6	6	9
11	11	9	10	5
12	9	8	6	5
13	7	9	6	4
14	4	7	3	2
15	5	7	5	1
16	4	6	4	1
17	3	6	0	1
18	3	4	2	
19	1	4		
20	1	3		
21		1		
22				
Mean and Probable error	10.81 ±0.2345	11.90 ±0.284	9.84 ±0.227	7.97 ±0.208

DISCUSSION OF RESULTS

Tillering power of lowland rice varieties

It is shown in table 10 that, under a given set of conditions, rice varieties differ in their tillering power. Some varieties produced more tillers than others. The number of fruiting culms to the plant ranged from 3.73 for Daluson to 10.84 for De la Cruz, and as high as 16.68 for Roxas. The excessive number of tillers of two varieties, however, 16.68 for Roxas and 15.47 for Macan Piña, may be considered exceptional since they were the only two varieties that greatly exceeded the average number of fruiting culms of the varieties studied, as shown in table 2. Upon closer examination of these two exceptional varieties, it was found that the fruiting culms tended to branch, so that where there should have been only one tiller, there were actually two or more. These varieties also were found to measure below the average height of the rice plant and to belong to the early maturing class. The 25×25 space allowed to each hill was probably favorable in these two cases; this coupled with the fact that ample time for development was allowed, induced the plants to produce an excessive number of tillers. These findings seem to agree with the assertion of Summers (1921) that when the plants are set rather far apart, three sets of tillers may arise, the last sets producing the smaller panicles.

Of the remaining 30 varieties, six, Bal-latini, Daluson, Iroy, Minantica, Murmuray, and Payapay, were found to fall below the average; eighteen, Azucena, Balayang, Conner, Colocjo, Cabarong, Calanay black, Calanay white, Hinaroan, Kinastila, Lumbang, Malabaco, Marintec, Mestizo, Los Baños Rice No. 1, Pulutan, and Tapol, to fall near the average; six, Apostol, Cochon, Cocong-Oac, Morado, Sipot, and De la Cruz, to fall above the average. In general, the short varieties appeared to tiller more than the tall varieties. Since all of the varieties from the time of planting to harvesting were treated in the same manner, it must follow that the significant differences in the tillering power between the varieties must have been due to some hereditary factor. Tillering, then, must be considered as a varietal characteristic, although its outward expression may be greatly modified by environmental factors as will probably be shown in the subsequent experiments.

The higher the average number of fruiting culms to the hill, the greater was the range of the number of fruiting culms and the larger also the probable error, as shown in table 10.

Among the varieties that produced fewer than 5 tillers to the plant, were Daluson, Murmuray, Minantica, Bal-latini, Iroy, and Payapay; around 5-6 tillers, were Kinastila, Malabaco, Lumbang, Colocjo, Mestizo, Marintec and Pulutan; 6-7 tillers, were Azucena, Los Baños Rice No. 1, Conner, Tapol, Cabarong; 7-8 tillers, were Balayang, Hinaroan, Calanay black, and Calanay white; 8-11 tillers, were Sipot, Cochon, Morado, Cocong-Oac, Apostol and De la Cruz.

TABLE 10

*Distribution of varieties according to their
average number of tillers per plant*

V	F	VARIETY NUMBERS
3.5	1	14
4.5	5	4-17-24-26-28
5.5	7	7-18-19-21-22-23-29
6.5	6	1-6-8-11-27-32
7.5	5	2-5-12-13-16
8.5	3	9-25-31
9.5	2	3-10
10.5	1	15

Mean = 6.78 $\pm$ 0.0118.

Date of flowering

The date of flowering was a little earlier in the plots where the hills were set at 12.5×12.5 and 25×25 centimeters, than where the hills were set at 50×50. The date of flowering was also earlier in the plots where the seedlings were transplanted when six or eight weeks old than when two or four weeks old. The range of the flowering season was longer where the seedlings were six or eight weeks old when transplanted, than when two or four weeks old. It was observed that when the range of the flowering season was longer, vegetative growth was more vigorous and production of tillers was greater than when the range of flowering season was shorter.

Effect of the method of planting on tillering

In table 3 it is shown that plants grown from seedlings transplanted from the seed bed to the field produced more tillers than when the seeds were planted directly in the field. In the transplanting method the average number of tillers for 100 plants was 9.84 ± 0.227 , while in the direct planting method, the average number of tillers for 100 plants was only 6.18 ± 0.142 , a difference of 3.66 ± 0.2675 . The transplanting method produced 59.2 per cent more tillers than the direct planting method. These results agree with the assertion of Jack (1921) that the transplanted plant produced more tillers than the directly planted plant. He also stated that on good soil, seedlings transplanted but once produced only one-fourth as much as when transplanted and split three times. Summer (1921) in his paper on the tillering of Ceylon rice says that Graham and Jack attributed the greater tillering power of transplanted rice to the root-pruning effects of transplanting and that the "shock" produced stimulates the growth of the sub-aërial portion of the plants, resulting in an increased number of tillers.

Effect of spacing on tillering

In table 4 it is shown that as the distance between hills varied, the number of fruiting culms to the hill directly varied. It may be seen that

as the hills were set further apart the plants produced more tillers to the hill. At a distance of 12.5×12.5 centimeters, the average number of tillers was 7.62 ± 0.18 ; at 20×20 , with three seedlings to the hill, which is the common method of planting, the average number was 8.77 ± 0.30 ; at 25×25 , with one seedling to the hill, 9.03 ± 0.20 ; and at 50×50 , 11.26 ± 0.29 . These results concur with the statement of Parr (1912), that the quantity of space allowed to each plant is the limiting factor of the power of the plants to produce tillers. They also agree with the findings of Jacobson (1917), of Jack (1921), and of Rodrigo (1924).

Although the number of fruiting culms to the plant increased relatively as the space was made wider, as shown in table 11, this increase was not in proportion to the increase in space. So that, when the number of tillers to the square meter was computed, as shown in table 5, the 12.5×12.5 centimeters distancing had twice as many tillers as the 25×25 centimeters spacing and about five times more than the 50×50 centimeters spacing. However, it was found by Rodrigo (1921), and in this he is supported by Jacobson (1917), that the number of fruiting culms to the unit area was not an indication of higher productivity of a given area. On the other hand, Jacobson (1916) found that tillering, the number of grains per panicle, and grain size were compensating characters. That is, increased tillering of the individual plant was accompanied by decreased number of grains to the panicle. It would not be incorrect, therefore, to infer that the comparatively smaller number of fruiting culms per unit area in the 25×25 spacing was compensated for by larger grain size and increased number of grains per panicle.

TABLE 11

Showing the relative stooling power as affected by the distance of planting

VARIETY NAME	COMMON METHOD	12.5×12.5 cm.	25×25 cm.	50×50 cm.
Apostol	100	86.88	102.96	128.39

Effect of rate of seeding on tillering

As table 7 shows, the rate of seeding affected the number of fruiting culms produced to the hill. There was a fairly regular increase in the number of fruiting culms to the hill, as the number of seedlings to the hill was increased. The average number of fruiting culms for one seedling to the hill was 9.17 ± 0.25 , for two seedlings to the hill, 10.48 ± 0.25 , for three seedlings to the hill, 11.66 ± 0.24 , and for four seedlings to the hill, 12.81 ± 0.32 . This increase, however, was not in proportion to the increase in number of seedlings, as shown in table 8. When the seedlings were increased from one to two, a 100 per cent increase, the increase in percentage of the number of fruiting culms was 14.28; increased from two to three seedlings, the

increase was 12.87 only; increased from three to four seedlings, the increase was 12.54 per cent. On the other hand, the seedlings reduced their tillering power by about 43 per cent when the number of seedlings to the hill was increased from one to two; 12 per cent when the seedlings were increased from two to three; and about 8 per cent when increased from three to four. These findings agree with the report of Lonsdale (1909) that rice possesses the property of tillering when planted singly, but this does not occur to any great extent when planted in bunches, varying from two to twenty seedlings. In general, the results show that increasing the number of seedlings to the hill from one to two or more, reduced the tillering power of the plant by about 50 per cent. This loss in the tillering power of the plant can be attributed ultimately to the limited space allowed the plant for development. Increasing the number of seedlings to the hill from one to two is equivalent to reducing the space of the individual plant from 25×25 centimeters to 12.5×12.5 , which distance in the present experiments was found to be insufficient for the plants to show their tillering power properly.

Effect of the age of transplanting on tillering

As shown in table 9 the tillering power of the plant was affected by the age of seedlings when transplanted. In the case of Apostol rice variety, seedlings transplanted when four weeks old produced fewer tillers than when planted at six or eight weeks old; seedlings planted at six weeks old produced more tillers than those eight weeks old; and the seedlings that were two weeks old gave the poorest tillering. In general, the results show that the tillering power of the plant increased with age of the seedling up to six weeks, when transplanted older than this, the power diminished.

The average number of tillers of 100 plants, transplanted when the seedlings were two weeks old, was 7.97 ± 0.208 ; when four weeks old, 9.84 ± 0.227 ; when six weeks old, 11.90 ± 0.284 ; and when eight weeks old, 10.81 ± 0.234 . It may be stated, therefore, that under Los Baños conditions, using one seedling to the hill and spacing at 25×25 , it is more advantageous to transplant the seedlings when six weeks old, than when eight, four, or two weeks old, because transplanting them at the age of six weeks the greatest number of tillers was produced, and it is known (Jacobson, 1921) that yield and tillering are decidedly positively correlated.

When six weeks old, the seedlings were strong enough to withstand the "shock" of transplanting and at the same time young enough to induce the sub-aërial portion to produce new tillers. The eight-weeks old seedlings were mature enough to withstand the "shock" of transplanting, but a little too old to allow the plant to produce many new tillers, as evidenced by the fact that the plants began to flower scarcely three weeks after planting. The two weeks old seedlings were too young to withstand the root-pruning

effects of transplanting, and their energy was spent in recovering from the "shock", so that comparatively few tillers were capable of developing. The behavior of the seedlings, however, when transplanted may be affected by how thickly the seeds were sown in the seed bed. If the seeds are sown thinly in the seed bed, the seedlings will grow faster than when the seeds are sown thickly. This being true, the four weeks old seedlings may be developed enough to withstand the "shock" of transplanting and at the same time produce many tillers, while the six weeks old seedlings may be too mature to be able to do so. It may be mentioned in this connection that no comparison was made as to whether the seedlings in this experiment were more thickly sown than is ordinarily done in this locality.

SUMMARY OF CONCLUSIONS

A study was made on the tillering power of 32 varieties of rice and on the effect of spacing, method of planting, rate of seeding, and age of seedlings at transplanting on tillering. The following conclusions may be drawn from this study:

1. Different lowland rice varieties vary in their tillering power. The average number of fruiting culms per plant ranged from 3.73 ± 0.13 for Daluson to 16.68 ± 0.57 for Roxas.

2. Varieties Daluson, Murmuray, Minantica, Bal-latini, Iroy and Payapay produced below 5 tillers to the plant; varieties Kinastila, Malabaco, Lumbang, Colocjo, Mestizo, Marintec, and Pulutan produced from 5 to 6 tillers to the plant; Azucena, Los Baños Rice No. 1, Conner, Tapol and Cabarong, from 6 to 7 tillers; Balayang, Hinaroan, Calanay black and Calanay white, 7-8 tillers; while Sipot, Cochon, Morado, Cocong-Oac, Apostol and De la Cruz, all produced from 8-11 tillers. Roxas and Macan Piña were two exceptional varieties, each producing more than 15 tillers to the plant.

3. The higher the average number of fruiting culms to the hill, the greater was the range of variability of the number of fruiting culms and the larger, also, the probable error of the average number of fruiting culms.

4. Transplanting seedlings when four weeks old and using one seedling to the hill produced 9.84 ± 0.22 tillers to the hill, while direct planting the seed and keeping one seedling to the hill produced 6.18 ± 0.142 tillers to the hill.

5. The greater the space allowed to each plant up to a distance of 50×50 centimeters the larger was the number of fruiting culms produced to the plant. A distancing of 12.5×12.5 centimeters had an average of 7.62 ± 0.18 tillers to the plant; a distancing of 50×50 centimeters produced, an average of 11.26 ± 0.29 tillers to the plant.

6. The number of fruiting culms per unit area diminished as the spacing was made greater.

7. As the number of seedlings was gradually increased from one to four, there was a regular increase in the number of tillers produced to the hill.

8. The number of fruiting culms to the plant greatly diminished as the number of seedlings to the hill was increased from one to four. Using one seedling, 9.17 ± 0.25 tillers to the plant was obtained; using four, 3.20 tillers were produced to the plant.

9. Under Los Baños conditions and using Apostol variety, the older the seedlings were, up to six weeks, the larger was the number of tillers produced to the plant, older than this the tillering power diminished.

10. Using one seedling to the hill and a spacing of 25×25 centimeters, six weeks old seedlings produced 11.9 ± 0.28 tillers to the plant, while two weeks old seedlings produced only 7.97 ± 0.20 tiller to the plant.

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NOTE: THE 1927 LIVE STOCK FAIR¹

The Live Stock Fair, held in conjunction with the Philippine Carnival of 1927, was the second Insular Stock Fair ever held in the Islands. It was generally acclaimed to be the most important of the industrial and educational features of the carnival. About ₱12,000 and a large portion of the Carnival City with three buildings covering an area of 2,240 square meters were allotted for the live stock exhibits. Dr. Victor Buencamino, a practicing veterinarian and animal importer in the city of Manila, was the organizer and general factotum of the fair. To him should go a great deal of the credit for the success of the show. The principal sources of the animals exhibited were the Bureau of Agriculture, College of Agriculture, and private farms.

The following breeds of live stock were represented:

Horses: Arabian, Welsh, and improved native.

Cattle: Indian Nellore, Indo-Chinese, Hereford, Jersey, Ayrshire, Guernsey, and improved native.

Buffalo and Carabao: Indian Buffalo and Native Carabao.

Swine: Berkjala, Berkshire, Poland-China, Duroc-Jersey, and Yorkshire.

Sheep: Shropshire, Native, improved native and Indian.

Goats: Indian, Nubian, and improved native.

Poultry: Chickens: Barred Plymouth Rock, Buff Orpington, Rhode Island Red, Cantonese, Native Pit Games, Light Brahma, Dark Cornish, and Chinese silkies. Ducks: Indian Runner, Pekins. Geese: Toulouse. Turkeys: Bronze. Pigeons: Homer.

The College of Agriculture presented a special live stock exhibit on experiments in animal breeding that had been carried with the aim to find the best proportion of foreign blood to use on Philippine stock to produce improved animals adapted to Philippine conditions. The following animals were exhibited as illustrations of the progress made in these studies:

A. Grading Philippine Cattle with Indian Nellore:

1. One Indian Nellore bull
2. One Philippine cow
3. One grade Nellore steer
4. One grade Nellore cow
5. One three-quarters Nellore bull

¹ General contribution from the College of Agriculture No. 188.

B. Grading Philippine Cattle with Hereford:

1. One Hereford bull
2. One Philippine cow
3. One grade Hereford bull
4. One grade Hereford cow and calf
5. One three-quarters Hereford heifer

C. Cross breeding Hereford with Indian Nellore:

1. One Hereford-Nellore bull

D. Grading Philippine Carabaos with Indian Buffalo:

1. One Indian buffalo bull
2. One Indian buffalo cow
3. Two grade Indian buffalo cows

E. The carabao is often dangerous to man and beast with his long horns. Can he be dehorned successfully?

1. One hornless carabao bullock
2. One hornless carabao cow

F. Results of crossing Berkshire and Jala-jala Swine:

1. One Berkjala boar
2. Two Berkjala sows

This cross is now in its third generation of intensive selection. It is approximately three-quarters Berkshire and one-quarter Jala-jala. It is being kept at this proportion as a higher amount of Berkshire blood seriously affects the hardiness of the cross.

G. Grading up Philippine goats with Nubian:

1. One Nubian buck
2. One Philippine doe with 2 grade kids
3. One grade Indian doe with 2 grade kids

H. Los Baños Improved chickens:

1. One pen (1 rooster and 4 hens) of selected Cantonese.

Besides the live stock exhibits there were held Civilian Day horse show, Army Day horse show, and Dog and Cat show. Several events were staged on the field and on the track to show the education, training, beauty of form, action and speed of the competing horses.

Many of the College of Agriculture animals were entered in open competition with other animals in the following breeding classes:

1. Beef-work type
2. Beef type
3. Indian Buffalo dairy type
4. Improved native fat type of swine
5. Milch goat type
6. Cantonese chickens.

Blue ribbons were awarded the College entries in cattle in the beef-work type, the beef type, the buffalo dairy-work type; in hogs, in boar class, sow class, and herd class, all Berkjalas; in poultry, the Improved College Cantonese flock. Red ribbons (second place) were awarded beef type and cow class; sow class; two in goats, one buck and one doe. Third

place was awarded in beef type, thus winning all beef prizes. In all, the College entries were awarded seven blue ribbons, five red ribbons, and one yellow. No College animal entered in competition failed to win a prize.

The dehorned carabaos excited considerable curiosity, this being the first public demonstration that the carabao can be dehorned in spite of its large growthy horn.

One result which speaks for the value of the Live Stock Fair was the great demand for the College live stock, particularly our Berkjala hogs for breeding and for feeding purposes. Their merits were recognized when people were given the opportunity to see them.

The one drawback to the fair was the small number of farmers who availed themselves of the opportunity to see this exhibition of our best live stock. More publicity, more practical advertising next year should bring out the farmers and men connected with the agricultural development of our country. One of the most interesting features of the show was that showing how native stock could be improved to suit our particular needs.

Those who attended the fair were men and women intelligently interested in live stock. They were enthusiastic in their praise of the splendid animals and herds shown. Their interest and keen observation were attested by the number of visits they made to the exhibit and by their purchase of animals. It is of interest to note that conspicuous among those who were seen at the fair were many from Batangas, the province well known for live stock. This interest in stock-breeding explains why Batangas leads other provinces in raising fine horses, cattle, and hogs.

The Carnival Association is to be commended for its efforts to help in the development of the country's live stock industry—the backbone of our farming industry. The Association has initiated what is conceded in all progressive agricultural countries to be the most effective stimulus to live stock improvement. It cannot be expected, however, that the Carnival Association without aid will make this a permanent feature in its future activities. A live stock fair should be a permanent institution to be held at suitable regular intervals as the United States State Fairs, the Stock Fairs of Canada, of England, and other European countries. These are the results of the initiative and enterprise of farmers, aided in part by government subsidy.

MARIANO MONDOÑEDO
*Of the Department of Animal
Husbandry*

NOTE: BEEKEEPING, A PROSPECTIVE INDUSTRY IN THE PHILIPPINES¹

Without question, in certain regions of the Philippines beekeeping can be made a great success. In the mountainous regions of the Islands, wild honey bees of several species are abundant. The largest one (*Apis Binghami*) makes huge pendant cones hanging from the under side of limbs of the largest forest trees, to the size of a bushel basket or more. Honey forms the staple sweet of the wild tribes and is assiduously sought by them, beeswax being a common forest product. These bees are active practically the year round, there being honey producing flowers at all seasons.

One of the most attractive regions that I know of in the Philippine Islands is the province of Bukidnon in north central Mindanao. It is very similar in topography and climate to northern California, as rich and as beautiful and with even a better climate. It is high and cool and with the rainfall very well distributed. In many parts of the Islands the excessive rainfall through the wet season would not be favorable to hived bees. Here at Los Baños, we have five to six feet of rain in six months and at Baguio there is about fifteen feet annually and in many parts of the Islands this sort of thing alternates with a trying dry season. In Bukidnon, these extremes do not exist. Bukidnon promises to be one of the best fruit regions in the Archipelago. Citrus fruits grow there to perfection and I believe that, in the higher parts, some of the standard deciduous fruits will succeed equally well. At present such fruits are imported into the Islands at high cost. It therefore seems entirely possible that the combination of beekeeping and fruit growing will make an ideal one for Bukidnon. Also Bukidnon is a great cattle country and we have every expectation that it will be possible to raise alfalfa there, successfully. If this ever works out practically, the region will be still more attractive.

It seems to me that the greater risk of embarking upon beekeeping in this new country as a sole issue can be avoided by combining it with some other good enterprise like the raising of citrus fruits.

It is to be noted that the native honeys of the Philippines are all highly, characteristically, and very pleasantly flavored. I have not seen any native honey of the unflavored sweet of some of the American commercial honeys. The Philippine product therefore could be put upon the market as something entirely unique and different from other products of the kind.

CHARLES FULLER BAKER
Dean, College of Agriculture.

¹Experiment Station contribution No. 453.

ABSTRACT¹

The effect of climate upon the production of corn. PAULINO C. MENOR. (*Thesis presented for graduation, 1926, from the College of Agriculture, No. 253; Experiment Station contribution, No. 454*).—A detailed study on the relative influence of climatic factors upon the production of corn was carried on in the College of Agriculture from September 28, 1924, to December 22, 1925. Two varieties, the Calauan Yellow Flint, a native variety, and the Mexican June, a foreign variety, were used in this experiment. The climatic factors were rainfall, temperature, wind velocity, evaporation, and insolation.

The objects of the author in this work were as follows: (a) to find the part of the year most favorable for planting corn; (b) to study the relation of climatic conditions to the production of corn in the College of Agriculture; and (c) to find which of the climatic factors under Los Baños has the greatest influence on the production of corn.

Thirteen consecutive plantings were made. At intervals of 28 days the seeds were planted in plots. Only two plants were allowed to grow in each hill. The plants in all plots received the same cultural treatments. The criteria considered in this study were height of the plants, weight of the dry stalks, and weight of grains.

Rainfall was measured by using a rain-gauge in millimeters, temperature by means of a thermograph, evaporation and insolation were obtained by using the black and white atmometers. The white atmometer was used to record the evaporation of the air. The difference between the day reading of the black and white atmometers was used as a measure of insolation. Wind velocity was obtained from the Department of Botany of the College.

The author found that the height of the plants and the dry weight of the stalks on both varieties were closely related with the rainfall. The more rainfall there was the greater the height of the plants and the greater the air-dry weight of the stalk. This relationship holds true in all the cultures, except in January when the rainfall was light. The air-dry weight of the grain according to the author's results had no relation to the rainfall. The heaviest yields of the two varieties were 47.38 grams for Mexican June and 40.59 grams for Calauan Yellow Flint.

The temperature during the months of April and May was high but the production in these two months was very low. Therefore, the temper-

¹ Abstract presented as part of work required in English 6, College of Agriculture.

ature is not a limiting factor in corn production in the College of Agriculture. As to evaporation, the heaviest yields were obtained from the March plantings when evaporation was high. In most of the cultures, insolation and wind velocity apparently bore little relation to the production of grain.

The results obtained may be summarized as follows:

(1) The season most favorable for corn production is when the rainfall is about 312.6 millimeters. (2) Temperature, insolation, and wind velocity had no relation to the production of corn. (3) The best months for planting Calauan Yellow Flint corn were found to be March, December, and January. (4) The best months for planting Mexican June corn were found to be March, September, and June. (5) The month which proved unfavorable to corn production was August when the rainfall reached about 752.7 to 948.4 millimeters. (6) Evaporation influences corn production. Highest yield was obtained when the evaporation was high.

—Abstract by Mateo D. Jimenez.

EXTENSION DIVISION NOTES

The sugar industry of some towns of Batangas and Laguna has in recent years been very discouraging. Several *hacenderos* have been almost financially ruined and a great number are now in debt. A few days ago a very wealthy land owner of Lipa, Batangas, had to dispose the greater portion of his land in order to pay a debt of about ₱100,000. The heavy losses of these wealthy men is making the sugar industry in this region very unpopular. Sugar plantations are being so decreased every year that if conditions do not change soon the sugar industry in some towns of this region will be abandoned. There are several factors that are responsible for this decline of the sugar industry. Of course, the great fluctuations in price of sugar in recent years has a great deal to do with the present financial condition of the sugar farmers. Their lack of foresight may not be their fault, but the factors for which they are wholly responsible are the following:

1. They adopted the use of tractors which are sold to them on easy installment plans but the adaptability of which to their condition they had not tried. All lost thousands of pesos in the use of tractors. The debts of most of them were incurred in buying tractors which they found did not give them much benefit.

2. Their production to the hectare is very low and they do not strive to increase it. At present they are getting on an average only 15 tons cane to the hectare and they are content if, at times, they get 20 tons. In Negros a planter is worried if he gets lower than 65 tons.

3. Most of the Batangas sugar cane farmers manage their *haciendas* in a very poor way, giving them little personal attention. They let their farm managers (*catiuala* or *capataz*) attend to the whole business, going themselves to the fields only during the cutting season, and then for just a few hours.

4. Most of the *hacenderos* are ignorant of modern farming. They do not study their problems. They do not realize the value of things that would improve their farm conditions. They do not want to spend money for fertilizers and modern means that would improve their farms.

The central's agency has conclusively shown that the application of a few kilograms of fertilizer to the Batangas soil increased the production two to three times, yet most of the *hacenderos* are reluctant to apply fertilizer to their land. If the price of sugar does not reach as high as just after the war, which is not probable, and if the Batangas planters do not change their methods the future of the sugar industry in Batangas is very dark.

The citrus industry, which is considered the most important fruit industry in Batangas, if not in the Philippines, is bound to die out, if the right treatment for the orchards is not discovered. For several years (according to common belief, since the eruption of Taal Volcano in 1911) there has been a considerable decrease of productivity of the trees, and at present they bear fruit very irregularly. No one has been able to explain with certainty the real cause of the decline. Owing to this uncertainty in the behavior of their trees the majority of the growers are getting discouraged, and according to reliable information no one cares to start a new plantation. Coconut is being planted instead of citrus as it is a surer crop.

The Bureau of Agriculture is exerting all efforts to revive the past productiveness of the citrus trees. It has an experiment station in the region where the citrus is most grown. Experiments are being conducted in efforts to find a possible way of bringing back the past productiveness of the Batangas citrus. If the Bureau succeeds in reviving the industry to its former state, it will mean much in prosperity of the province and of the Philippines.

Feliciano Reveche, B. Agr. '23, who has his home in Sorsogon, capital of the province of the same name, writes the College Extension Agency to the effect that he has under serious consideration a proposal for developing 160 hectares of land, presumably in Sorsogon, to a plantation of coconut and fruit trees in conjunction with a poultry and hog industry. The owner of the land is to furnish the necessary capital to finance the enterprise, and Mr. Reveche is to manage it in the capacity of a partner (*socio industrial*). Mr. Reveche asks for advice to insure the success of the enterprise.

The College Extension Division has recently received a written report from Mr. Leon Katigbak, an *hacendero* in Lipa, Batangas, on the results of the first trial he made with the College Cassava Machine on his farm in Lipa. A free translation of his report from Spanish into English is as follows:

I am sending herewith data on the results of my work in extracting cassava starch and by-products made possible by the use of the College machine which you so kindly loaned to me and for which I am deeply grateful.

My plantation of camoteng cahoy (cassava) was set out in the month of January of last year (1926) and was harvested last February. The land used for this crop was plowed and was not given any further cultivation. The baguio of last November knocked the whole plantation flat to the ground; as a result 80 per cent of the main tubers were uprooted. For this reason only some secondary tubers could be utilized with our present trial of cassava starch making.

For this plantation about 10 per cent of the whole amount of seed used was the variety locally called Balinhoy, rated here as the best variety. The remaining 90 per cent of the seed was collected from wild growth found on the banks of nearby streams; this seed is of unknown varietal identity, we knew them only as wild camoteng cahoy.

Judging by conditions under which I made my first trial, it would be worth while to engage in growing this crop by selecting a good variety and securing a fixed market for the product.

I am having under careful observation the efficiency of the cassava bagasse obtained from extracting the starch as feed for hogs.

Statement of results of starch extraction and expenses in running the College grater.

Total net weight of the tubers peeled and cleaned.....	3,800 kgm.
Total net weight of starch obtained.....	581 kgm.
Total net weight of milled bagasse for hog feed.....	794 kgm.

Expenses incurred.

For pulling the tubers in the field.....	₱ 51.00
For peeling the tubers.....	38.00
For milling the cassava and collecting the starch and bagasse.....	18.40
Total of expenses.....	₱107.40

Value of the product.

581 kgm. of cassava starch at ₱0.20 a kgm.....	₱116.20
794 kgm. of cassava bagasse at ₱0.07 a kgm.....	55.58
Total.....	₱171.78
Expenses.....	107.40
Profit.....	₱ 64.38

Note:

Expenses for fuel in running the motor were not accounted for as the cassava grater as well as the mill for grinding the cassava bagasse were run by belting them to the engine of the sugar mill while the milling of the sugar cane was going on. But had a separate

motor been used for the cassava machine, the expense for fuel would have run to a little more than half a centavo per kilogram of peeled and cleaned tubers.

The production per hectare of the cassava used in this trial was not estimated, due to the fact that the plantation was badly damaged by the strong baguio that devastated Tayabas, Laguna, and Batangas, last November. Besides this, the plantation was not given anything like ordinary cultivation. And the variety used was the wild one found springing up in uncultivated places on river banks.

Under proper cultivation, 15,000 kilograms of cleaned and peeled tuber can very well be obtained from a hectare, if a good variety is used. On this basis and using the figures above indicated the value of the crop would be ₱256.20 per hectare.

The trial as above reported is the first test made by a farmer with the College improved cassava grinder. According to his figures he obtained a little more than 15 per cent extraction. But he is very optimistic about a much better result in his subsequent trials as he feels he can improve conditions in the management of his cassava plantation and in operating the machine. With improved conditions he is expecting to make with the College grinder an extraction of about 20 per cent, comparable to the efficiency of an iron made machine in foreign market. This same cassava grinder when tested on the College ground in 1921 gave an extraction between 23 and 24 per cent of air-dry starch.

One remarkable thing about the latest trial with the grinder by the Lipa farmer is the utilization of the cassava bagasse as a feed for hogs. In our last visit to Lipa to ascertain the results of his trial, the farmer gave us the information that he could sell this bagasse quite readily in the locality at the rate of 10 centavos a kilogram although in his report given here he allowed 3 centavos off as a margin of safety. He did not, however, sell any of the bagasse for he was feeding it himself to his own hogs for observation on its feeding effect.

The grinder in question is being kept on the farmer's *hacienda* in the barrio of Tejiro, Lipa, Batangas, open for inspection upon notice given the *hacienda* owner who resides in Lipa. He will use it as a model for constructing one locally for his own use. "The grinder is made largely of native hard wood, consisting of a revolving drum covered with a sheet of corrugated iron punctured to make a grating surface. This is provided with a set of wooden gears which set the cylinder in motion. Over this a hopper is arranged, the whole resting on a suitable frame. A stream of water plays on this cylinder so as to keep it washed from grated material. After the material is grated, it falls on an oscillating sieve which is set at a slight angle so that the fiber which is left after the starch is washed out falls off the lower end. The starch and water fall through into a trough which has a very

slight pitch so that the current is slow, allowing the starch to settle as the water is drawn off." Both the grating cylinder and the sieve are run at the same time. In the case of the trial made on the College ground a two-horse-power Fairbanks Morse engine was used to run the grinder; but in the trial made by the Lipa *hacendero* the mill was run by belting it to a 25-horse-power engine of a muscovado mill while grinding sugar cane. According to Prof. Harold Cuzner, formerly head of the College Engineering Department, who designed the machine on the principle of a small hand grater, the efficiency depends on having the teeth on the cylinder as fine and sharp as possible. It is highly important in the process of grating that the cassava tubers be applied on the grating cylinder endwise so as to break most of the cells and liberate the starch contained in them.

EXCHANGE NOTES

Nipah in the Philippines and Borneo is definitely seasonal, tapping being confined to six or seven months. It cannot therefore be exploited in these countries except by an indigenous population, who have other work to occupy them during the non-yielding months, or some alternative cultivation for an imported labour force. Nipah in the F. M. S. is not seasonal; tapping can be continued the whole year round.

—*The Planter* (Federated Malay States).

The Premier has announced the Government's intention to inaugurate "Better Farming Train" in New South Wales, with a view to encouraging improved farming methods and greater production. . . . When the train has been equipped it will visit the farming districts, and experts in all branches of agriculture will advise on cultural methods, disease and pest control, packing and preparation for market, the care and management of stock, and other subjects in which the farmer is directly interested. Old methods in agriculture, the Premier points out, must give way to new methods, otherwise production becomes limited to a protected local market, our products being unable to compete in foreign countries where the more scientifically produced goods of our rivals can undersell us. Profitable production is not merely a matter of wages and hours; it is a question of concentration, organization, and up-to-date methods.

The main objective of the train will be to bring the rural communities more directly into touch with the Departments which exist for their welfare. The resources of Departments such as Agriculture, Health, Education, and the Rural Bank have not in the past been fully availed of, for the proper development of the State and the improvement of country conditions, and a feeling has grown up in the minds of our farmers and settlers that they are denied opportunities and assistance which are readily at the disposal of city folk.

—*Agricultural Gazette* (New South Wales).

Honduras has a new banana dehydrating industry started, using a newly invented machine of German origin for the dehydration.

It consists of one dryer, which used either wood or crude petroleum for fuel. The dryer contains 23 hollow plates through which steam passes, heating 175 shelves, holding 60 bananas each. The process is based on the principle of dry heat in a partial vacuum, and takes from 5 to 10 hours, according to the percentage of moisture to be extracted.

The bananas dried by this process are sweet enough to be used as a candy without further treatment. However, it is the plan of the producers to ship the product to the United States and Europe as a prime material in wholesale quantities, to be used as fillers for candies, biscuits, and similar products. The dried product is made from ripe fruit and at the present time the supply is obtained from local plantations.

—*Extension Letter* (University of Hawaii).

Salt was commonly supposed to be a dangerous ingredient of poultry feed. Now it is used and recommended by all practical poultry raisers. It encourages drinking, adds to the palatability of the ration and supplies needed minerals.

Tests recently reported by the University of Illinois show that chickens can be raised on rations containing as high as 8 per cent of salt with no apparent harmful effects. The usual amount of salt mixed with the mash is about one per cent. Fine table salt mixes better with the feed as it is less likely to contain lumps than is coarse barrel salt. Lumps of salt when eaten by chickens often prove fatal.

—*Successful Farming* (Iowa).

Possibly nothing in the way of new discoveries or new methods of transmission has spread with the rapidity of radio. . . .

The great mass of broadcasting stations scattered throughout the length and breadth of this globe makes it possible for the people of every land to have almost continuous entertainment at a nominal cost.

* * *

Nothing, not even the telephone or the automobile, has done as much to bring to the rural homes of the country that entertainment which, before the advent of the radio, was only available to those residing within the corporate limits of our big cities. Therefore we believe its influence on the youth of the rural districts is going to be for the best, particularly if proper supervision prevents the broadcasting of entertainment of questionable character.

—*Cultivator* (California).

COLLEGE AND ALUMNI NOTES

Professor Pontrodonia, horticulturist of the Commonwealth Department of Agriculture, Australia, and located at Melbourne, was on the Campus on May 5. Professor Pontrodonia was *en route* to California, where he expects to spend a year in studying methods of fruit growing. He was greatly impressed with the large College that has been developed here, and was surprised at the relatively small amount of money that has been required—a mere fraction of an appropriation that his department received from the Commonwealth Government for one line of activity alone. He said of our Dean Baker, “If the people of the Philippines realized what he is doing for the country, they would build a monument to him.”

A second children's book on Japan by Associate Professor Emma S. Yule has recently appeared. The reader learns of the home life, school life, dress, customs, games, etc., of Japanese children through some forty colored illustrations made from colored photographs, stories, rhymes, and little plays. Artistic in binding, paper, type, and illustrations, as a piece of bookmaking *In Kimono Land* is a credit to the publishers, Rand McNally Company, Chicago.

Dr. F. O. Santos, Associate Professor of Agricultural Chemistry, and member of the Beriberi Control Committee, spent some time in April in Nueva Ecija on field work. He gave a lecture on “Filipino food materials containing beriberi vitamin” before a joint convention of medical inspectors and teachers in Baguio during the Summer Session.

Dr. and Mrs. Felipe T. Adriano arrived on the S. S. *Coblentz* April 30. After receiving his Ph. D. in Cornell University, Doctor Adriano visited different universities of the United States and returned to the Philippines *via* Europe. He returns to the Department of Chemistry as lecturer on Quantitative and Qualitative Chemical Analysis.

The Summer session class in Agronomy V (Survey of Philippine Crops) with Mr. Z. Montemayor in charge visited the Calamba Sugar Estate on May 7. Messrs. Dawis, Medrana, Mercado, and Novero of the Department of Agronomy were also with the party. Both the sugar cane and the coconut plantations on the estate were visited with the purpose of acquaint-

ing the students with the management of these projects. A lecture on operation of sugar cane fields by Mr. H. J. Rothkirch, Assistant Superintendent of the Estate and on coconut plantation operation by Mr. Tacad of the management personnel, gave the students valuable information about the management of these two crops. The copra drier used by the estate was also visited. The party returned to the College greatly impressed with what they had seen.

The College is indebted to the Calamba Sugar Estate authorities for the kindness and help extended these visiting students.

Assistant Professor Cecilio Alincastre gave a twenty-minute lecture on the Sugar Technology Course offered at the College of Agriculture to the audience of the Radio Manila on April 14.

Dr. Elias Pañganiban, Assistant Professor of Chemistry, resigned, effective April 1, 1927. He is now managing a farm in Negros Occidental.

On April 3, the Binacayan Tennis Club, one of the leading tennis clubs of Cavite, visited the Campus and held a very successful all day tournament with the Faculty Tennis Club. Among the players who exhibited exceptional skill in driving and placing were Messrs. Ignacio and Ferre of the Binacayan Tennis Club and Dr. S. A. Francisco, Prof. C. Sulit and Mr. R. Tolentino of the Faculty Tennis Club. Because of the numerous matches scheduled only two sets were allowed each match. The standing of the teams was:

	<i>Won</i>	<i>Tie</i>
Faculty Tennis Club.....	10	2
Binacayan Tennis Club.....	4	2

Miss Presentación Bersaimin, instructor in mathematics in Manila North High School was a member of the class in the Practical Course in Poultry Husbandry given by Doctor Fronda in the Summer School. Miss Bersaimin plans to make poultry raising one of the projects on her large farm near Bangued, Abra.

Messrs. Severino Etorma and Amado Balagtas, B. S. '27, are graduate assistants in the Department of Agricultural Chemistry. Mr. Etorma is assisting in the investigation on coconut oil and Mr. Balagtas is working in the Experiment Station Food Laboratory.

The U. P. Sugar Mill completed grinding on April 18, having bagged 3,080 kilograms of washed sugar from 62 tons of cane—a recovery nearly 18 per cent more than that of the previous year. The entire operation, including the cane milled outside, brought in a gross profit of about ₱1,000.

The following students completed their practice at the Mill: F. de Jesus, E. Eubanas, G. C. Bermejo, and V. Severino.

Brígido A. Huligaña, member of Class '28, died suddenly on May 6 in Philippine General Hospital after very short illness.

Mr. Huligaña entered the College June, 1924, from San Fernando High School. His scholastic work in College was excellent, the average at close of College year 1927, being 1.96. He had carried extra subjects so that he would have completed the four years' course in three and one-half years. In Military Science his work was of high rank. Last year as Captain of Co. "I," he was awarded Leadership Medal for highest quality of command and leadership. In target practice for same year he ranked first as sharpshooter.

Mr. Huligaña was prominent in College activities; was member and for one semester president of the Mimics and was in cast of two or more plays presented by this club; was member of Junior Agricultural Congress; Chairman, Committee on Social Affairs of Student Body, 1926, and Vice-President, Student Body, 1927; was member of Board of Management of *Philippine Collegian* 1926-1927; and Representative to University Student Council 1926-1927.

Resolution adopted by the Student Body.

Whereas, it has pleased Almighty God to call from our midst to the Great Beyond our highly esteemed College mate, Mr. Brígido A. Huligaña.

Whereas, he was a worthy and valuable member of our College community and a student of ability and painstaking industry, influential in college activities, valuable in shaping our present admirable Student Body Government,

Whereas, by his manly qualities and willing unselfish service he had won the admiration and esteem of the College Community and,

Whereas, his untimely death is a great loss to the Student Body, an irreparable loss to his parents, and deprives the Country of a future citizen of more than usual promise; therefore, be it

Resolved, that the members of the Student Body of the College of Agriculture now in Summer Session express their heart-felt sorrow and sympathy, as they do hereby express, to his bereaved parents, and record their own grief and sense of loss, and be it further,

Resolved, that a copy of this resolution be sent to Brígido A. Huligaña's parents, a copy be sent to THE PHILIPPINE AGRICULTURIST for publication, and a third copy be filed in the Statute Book of the Student Body Government.

The Committee:

MARCELO B. PEÑA, *Chairman.*

MANUEL B. VILLANO, *Member.*

GAUDENCIO A. VENTURA, *Member.*

CALLED TO THE GREAT BEYOND

CHARLES FULLER BAKER

**Dean College of Agriculture and Director
Experiment Station**

**July twenty-two, nineteen hundred twenty-seven,
after three weeks illness**

*"He was an advanced investigator. He sought the truth
and he entered the house of truth with open mind,
without prejudice or fear. His industry
bore constant fruit."*

This number of the PHILIPPINE AGRICULTURIST "The College in Retrospect" was in press when Our Dean passed to his final rest. It had been prepared at his special request—his last regarding this publication, in which he ever took a vital interest.

Farmers, as well as other business men, are admonished to take stock periodically. It is well for all of us to take stock occasionally, if not periodically; to pause and turn our minds on days gone by, to spend a brief space in retrospection, recall what manner of men we were a few years since; what our condition, what our aspirations. Then in our stock-taking we may compare, strike a balance. Whether this balance brings a glow of satisfaction or a chill slap of dissatisfaction, it is good for us; the quality of the good depending on the sort of stuff our souls are made of.

Retrospection, stock-taking is good for a college. With this belief this College set apart this number of *THE PHILIPPINE AGRICULTURIST* to record an informal stock-taking, a little retrospection, some reminiscence, a summing up, a few contrasts. We believe it well for our students to know something of the spirit of the pioneers of ten, fifteen, nearly twenty years ago. We believe it well for these pioneers to spend a little time with memories of other days. They were good days; they were sifting days.

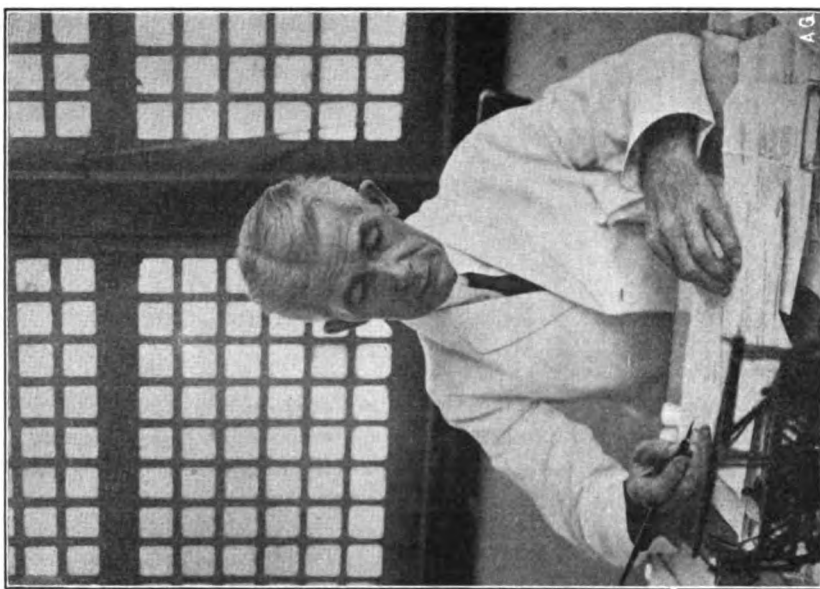
It is well for all, of the early days, of the present days to give their meed of praise, pay their tribute of gratitude to the builders of the College of Agriculture.

It is well for us to pause, to consider, and to answer frankly and honestly the question—"Have we quit ourselves like men?"

E. S. Y.



EDWIN BINGHAM COPELAND
Dean, June 14, 1909, - August 30, 1917



CHARLES FULLER BAKER
Dean, September 27, 1917, - July 22, 1927

OUR TWO DEANS

IN RETROSPECT¹

It is eighteen years since the College of Agriculture first opened its doors. They have been busy years and have left little time for meditation and introspection on what has been accomplished. But, as the Mount Maquiling climber when he has reached the first peak usually stops to view the lay of the land below him which he has so toilingly passed over, we may well pause and look in retrospect at what these eighteen years have meant to this institution and the country.

It was as early as 1908 when as a student of botany in the Philippine Normal School, then a sort of a Junior College and the highest government institution of learning, I witnessed the first labor pains that brought forth this College. Dr. E. B. Copeland, our instructor, was often absent from school on the mission of exploring locations suitable for the establishment of a College of Agriculture. It seemed obvious enough that such an institution was a necessity in a purely agricultural country, but there were many skeptics who believed it was not practicable, as the educated Filipino would not allow his son to besmirch himself in manual labor. Doctor Copeland had more faith in the youth of the land and this faith was the talisman he kept in overcoming opposition to his plans.

In June, 1909, the College was formally opened as the College of Agriculture, the first college of what was to be the University of the Philippines, with Doctor Copeland as dean. All preliminary organization was under the Bureau of Education and practically all of the first faculty, as well as most of the students, were recruited from the teaching force of the Bureau. Few of us appreciate how much we owe to the Bureau of Education, our foster-mother, nurse, and sponsor.

The plans, large, unlimited, were deeply engraved in the mind of the master builder, but nowhere else to be found, for he feared that if they were known, they would instantly arouse opposition and antagonism, for they were premised not on facts but on an ideal he had yet to demonstrate; the capacity of the Filipino to do scientific work. The big plans, rather monumental, would be apt to bewilder the onlooker who figured costs rather than results. The actualities were sorry to behold—borrowed army tents for recitation rooms, rattan stools instead of chairs, and as for desks, their number and amplitude was commensurate with the flesh one carried on his thigh. It would be difficult to find a better counterpart for Mark Hopkin's University, with himself on one end of a log and the student on the other, than our College in these first days. The results were strikingly similar. Everybody was burning with enthusiasm, all students and faculty

¹General contribution from the College of Agriculture No. 189.

were living on ideals and hopes, the usual ethereal nourishment of the builder and the creator.

In the beginning a great share of the student body had to be paid to attend school—they were teacher pensionados detailed to study so they might return to their particular communities as apostles of better farming methods. From a humble beginning of a faculty of five, fifty students, no buildings, and eighty hectares of wild land, the College is now an institution with a faculty of eighty-eight members, about eight hundred students, sixty-one buildings, and about four hundred hectares of improved land. The number of pensionado students now is negligible, coming for the most part from the special provinces inhabited by our non-christian population.

There has been constant progress from year to year, and had we the time and space, we could make every building and improvement tell its own story of struggle before it could be put through. It would reveal to us, too, the names of staunch friends of the College, who like its builder saw visions in the institution where many others saw only a phantasma: Gilbert, White, Palma, Pablo, Albert, Yeater, Cailles, Quezon, and Wood, the Agricultural Congress, and the Hawaiian Sugar Planters Association are a few of the names that come to mind just now. There is a host of others whose interest and efforts would have borne more substantial fruits had the times been more propitious.

But the student body, the buildings, and the equipment are only the material expressions that have evolved from the deeply laid plans of the master architect. It was his dream to found here a real university college of agriculture that would be the peer of the best anywhere in the world—nothing less would be good enough for the youth of the Philippines. It was also part of his plans that it should be a live institution, not simply a dispenser of second hand information, where the imparting of knowledge would go hand in hand with its acquisition. The list of contributions that appears elsewhere in this issue is the best proof of how well the plans have materialized.

Doctor Copeland was with the College until 1917. He had built a very solid foundation and was confident that it would stand under the guidance of the man whom he chose to succeed him.

How well the foundations were laid can best be appreciated when they suffered practically no modification in the hands of the second administrator of the College.

In 1912, Professor C. F. Baker came to us as professor of agronomy, bringing with him a wealth of experience from about half a dozen countries of tropical America and the southern United States. He was enjoying the peace of congenial work in a professorial chair in a lusty American college when Doctor Copeland talked him into coming to the Philippines to lend a hand in the great task he had mapped out. The challenge was too strong to go unheeded and Professor Baker took it up. Though he is of pioneer stock, from

the Wisconsin frontiers, he was dumbfounded at the seeming hopelessness of carrying out such elaborate plans, where there was nothing but nature let loose. His recovery was swift, however, and he soon put shoulders to the wheel in making realities of dreams. Soon after Dean Copeland retired, Professor Baker was called to the Deanship. None could have continued the good work better than he. He knew the ideals of Doctor Copeland and saw to it that the well laid plans of his predecessor were carried to fruition. He is primarily responsible for the material growth of the College. The present visible superstructure is largely due to his efforts.

The College has ceased to be an experiment and an enigma; its graduates and former students all over the Islands, directly and indirectly, are serving the community and creating wealth to serve as a material foundation for a greater Philippines. The information gleaned from its laboratories is eagerly sought here and abroad. The institution is rapidly assuming its rightful place as a clearing house for agricultural information for this part of the globe for the benefit of the Philippines and the world as a whole.

The spirit of service that has been stamped on all efforts of the College by its two deans is ineffaceable and will constitute its best guarantee of a perpetual life of usefulness.

One incidental product, which however is fundamental to the existence of the College, is the training of a Filipino personnel to man it. The founder realized early the futility of expecting Americans to man institutions in the Philippines for all time. In this he was ably seconded by his successor who continued the policy with greater vigor. From the very beginning the most promising members of the student body were taken in hand and given gradually greater tasks and greater responsibilities in the conduct of the institution. Progress was always measured and advancement came as a consequence or as a reward of merit. Promotions were never forced, outside influences were unknown, and the faculty of the college is being gradually Filipinized without a jolt, without a break. There have been many great American administrators in the Philippines, but few of them realized that in the end and for the sake of continuity, Filipinos must be properly trained to take up the work, for it is an undeniable fact that the average individual service of Americans in the Philippines is ridiculously brief. When the time came for them to leave, their work was paralyzed altogether in some cases, or at best had to be continued after a fashion by inexperienced hands and with results often disastrous to public service and the work on hand.

What others think of the work in Los Baños is best illustrated by a paragraph quoted from a letter to Dean Baker from Professor Earle, oldest and most experienced American in tropical agronomy:

The biggest of all is that bunch of boys you have been training. It has been a perfect marvel to me that you have been able to take such absolutely raw material and turn out really finished scientific workers in so short a time. I have never read a paper by one of your young chaps without being amazed by the high class work they are doing. You have made a mark that no kind of future misgovernment can entirely rub out. When a few of these trained men get into political power it will mean wonders for the future government of the islands.

Let there be no misunderstanding, let no impression be created that the College is the work of only one or two individuals. Diligent hands have come and gone, each leaving his stamp on the mosaic. Without making mention of those still with us, it is a pleasure to recall the names of the Ledyards, Cuzner, Durham, Manas, Glodt, Deming, Reinking, Hester, Ashton, Holman, Gates, McLean, Trelease, Herbert, Higgins, Gillis, Kenward, Coocanouer, Duncan, Woodworth, McWhorter, Madison, Welles, Taylor, Hall, O'Leary, and others. They all did their part and left us happy in the feeling of "work well done, thou good and faithful servant."

B. M. GONZALEZ,
Of the Department of Animal Husbandry.



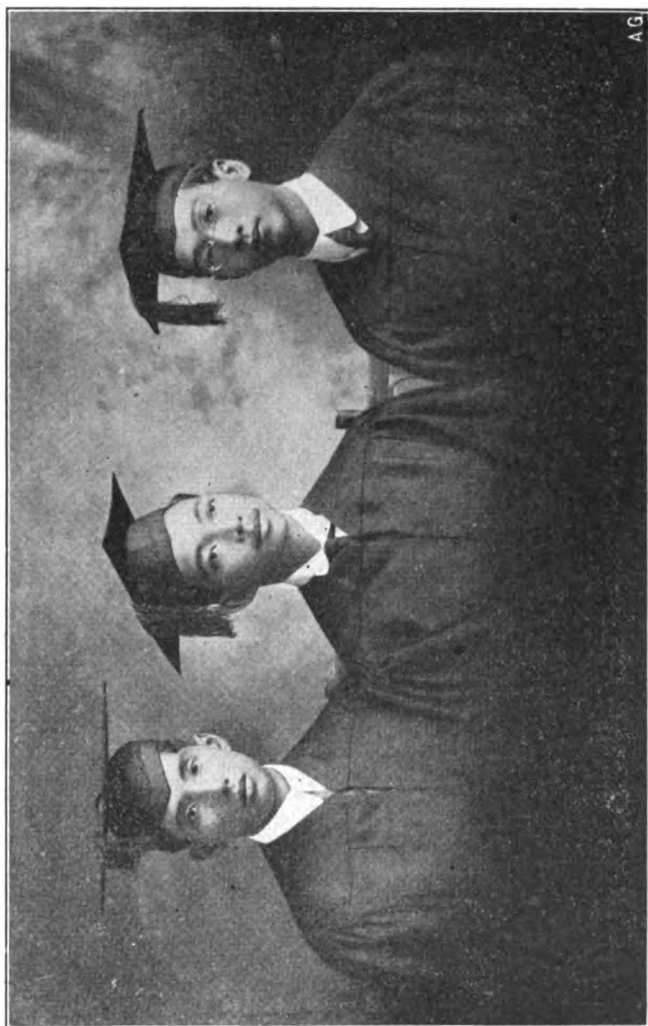
Bronze Tablet placed, 1918, in Administration Building by
College of Agriculture Alumni

DEAN BAKER'S GREETINGS TO THE STUDENT BODY OF
THE COLLEGE OF AGRICULTURE
(From *Philippinensian* for 1926.)

About fourteen years ago when I came to the campus of the College of Agriculture, very few students could be found there. The campus was largely wild land, lacking laboratories, dwellings and dormitories and most of the other things that go to make a college. One thing, however, it did *not lack*, and the continued presence of this element has made it possible to carve a great college out of the "Bunduk", to "carry on" through all discouragements and setbacks, to weather all the knockings and animadversions, and finally to bring into being a campus beautiful, laboratories fruitful, and a college spirit of which we may justly be proud. All this has been due in no small degree to the splendid *response* on the part of our students to every effort made *for them* and *with them*. In my private opinion this has been due largely to the fact that no one has ever attempted to either "lead" the students—as that word is commonly applied—or to *drive them!* They have been *co-workers with the faculty members throughout*, in innumerable ways, and in democratic and friendly ways. Faculty members have never asked students to do work that they themselves were either afraid or ashamed to do, but rather have asked students to work *with* them, from swinging a bolo in clearing, to being soaked by the same rain, stained by the same soil, greased and smutted from the same tractor engine, and to fighting on through interminable laboratory intricacies and difficult courses side by side. Our faculty members have always been hard workers and active students themselves and this is the only way in which real "leading of students may be done".

The students have taken a large part in the actual building of the College and its great indoor and outdoor laboratories, and in the elaboration of the great body of applied science which now forms the basis of all its applied instruction. All of this has meant things of the highest order of value to the students themselves, and it will continue to mean greater and greater things to the students who come after them.

This policy—the policy of the Golden Rule—the policy of co-operation, the policy of friendliness, the policy of "leading by doing," also elsewhere in the world, has built some of the most effective colleges and laboratories known. May such a policy continue to flower at the College of Agriculture through all the days!



AG

FIRST GRADUATING CLASS, 1911

Left to right:—Clodoaldo Tempongko, José Zamora, Manuel L. Roxas

BY THEIR FRUITS YE SHALL KNOW THEM

ALUMNI OF THE COLLEGE OF AGRICULTURE

CLASS OF 1911

Bachelor of Science in Agriculture

ROXAS, MANUEL L., M.S. (Univ. Phil.), Ph. D. (Univ. Wis.)

Los Baños-College, Laguna.

Professor of Agricultural Chemistry, Head of Department, Consulting Sugar Technologist, Philippine Sugar Association.

Land Owner.

Bachelor of Agriculture

ZAMORA, JOSÉ, Master Farmer (Univ. Phil.)

957 Padre Faura, Manila.

Land Owner. Farmer.

CLASS OF 1912

Bachelor of Science in Agriculture

ALLAREY, VICENTE

Lucena, Tayabas.

Agricultural Extension Agent, Bureau of Agriculture.

Land owner.

ASUNCIÓN, SILVESTRE, M.S. (Audubon Sugar School)

Balayan, Batangas.

Farmer.

CEVALLOS, FELIPE, M.S. (Univ. Phil.), Ph. D. (Univ. Wis.)

Catarman, Samar.

Teacher, Catarman Agricultural School.

Land owner.

NAVARRO, ANDRES, M.D. (Univ. Phil.)

Aroroy, Masbate.

Farmer.

VIBAR, TORIBIO, B.S.A., M.S. (Univ. Phil.), Ph. D. (Univ. Ill.)

Los Baños-College, Laguna.

Assistant Professor of Agronomy.

Land owner.

CLASS OF 1913

Bachelor of Science in Agriculture

CRISOSTOMO, MARCELO

La Castellana, Occ. Negros.

Farmer.

LEDYARD, EDGAR M.

P. O. Box 1785, Salt Lake City, Utah, U.S.A.

Agricultural Superintendent of a Smelting Company.

Bachelor of Agriculture

ALBANO, SOTERO F.

Cebu, Cebu.

Inspector for Fiber Standardization Board.

BAGUI, FLORENCIO G.

Odiongan, Romblon.

Teacher, Odiongan Farm School.

BARTOLOME, VICENTE C.

Manila.

Secretary-Treasurer, Fiber Standardization Board.

GONZALES, BIENVENIDO M., M.S. (Univ. Wis.), D. Sc. (Johns Hopkins Univ.)

Los Baños-College, Laguna.

Professor of Animal Husbandry, Head of Department.

Land owner.

LEJANO, ANTONIO

Cebu, Cebu.

Chief Inspector for Fiber Standardization Board.

Land owner.

MUÑOZ, APOLONIO R.

Lagao, Albay.

Farmer.

VILLEGAS, VALENTE E., Ph. D. (Iowa State College)

Los Baños-College, Laguna.

Assistant Professor of Animal Husbandry.

Land owner.

CLASS OF 1914*Bachelor of Science in Agriculture*

MENDIOLA, NEMESIO B., M.S. (Univ. Phil.), Ph. D. (Cornell Univ.)

Batavia, Java.

Associate Professor of Plant Breeding, College of Agriculture, U. P., Fellow, Rockefeller International Education Board. (On leave, in Java.)

CAMUS, JOSÉ S.

Manila.

Inspector-at-Large, Bureau of Agriculture.

Land owner.

GALANG, FRANCISCO

Manila.

Horticulturist, Bureau of Agriculture.

Land owner.

LAPARAN, AMANDO

Manila.

Agricultural Extension Agent, Bureau of Agriculture.

Land owner.

MERINO, GONZALO F., M.S. (Univ. Calif.)

Manila.

Chief, Division of Pest Control, Bureau of Agriculture.

Land owner.

QUISUMBING, FRANCISCO A., M.S. (Univ. Phil.), Ph. D. (Columbia)

Manila.

*Assistant Professor of Chemistry, College of Liberal Arts, University of the Philippines.
Manufacturing chemist.*

SABLAN, ELADIO

Manila.

*Assistant Agronomist, Bureau of Agriculture.
Land owner.*

TIRONA, JOSÉ P., M.D. (Univ. Phil.)

Manila.

*Employee, Bureau of Health.
Land owner.*

ZULAYBAR, EUTQUIO Q.

Legaspi, Albay.

Chief Inspector for Fiber Standardization Board.

CLASS OF 1915

Bachelor of Science in Agriculture

ALDABA, VICENTE C., M.S. (Univ. Phil.), M.S., Sc. D. (Harvard Univ.)

Los Baños-College, Laguna.

Assistant Professor of Agronomy.

AURELIO, CATALINO G.

Binalbagan, Occ. Negros.

*Chemist, Binalbagan Sugar Estate.
Land owner.*

DACANAY, JOSÉ Q.

Manila.

Technical Assistant, Bureau of Agriculture.

MIRASOL, JOSÉ J., M.S. (Univ. Phil.), Ph. D. (Univ. Ill.)

Cebu, Cebu.

Teacher, Visayan Institute.

TEODORO, NICANOR G., M.S., Ph. D. (Univ. Wis.)

Manila.

Assistant Chief, Pest Control Division, Bureau of Agriculture.

UICHANCO, LEOPOLDO B., M.S. (Univ. Phil.), M.S., Sc D. (Harvard Univ.)

Los Baños-College, Laguna.

*Associate Professor of Entomology, Acting Head of Department.
Homesteader.*

Bachelor of Science in Forestry

RACELIS, ANTONIO P., M.S.F. (Mich. Univ.)

Manila.

*Employee, Bureau of Forestry.
Land owner.*

VILLAMIL, ANICETO

Dumaguete, Oriental Negros.

Farmer.

Bachelor of Agriculture

CAPISTRANO, SEVERO M.

Ames, Iowa. U.S.A.

Bureau of Agriculture Pensionado, Iowa State College of Agriculture.

Land owner.

CONSTANTINO, AGRIPINO

Morong, Rizal.

Supervising Teacher, Bureau of Education.

Homesteader.

ESPINO, RAFAEL B., Ph. D. (Johns Hopkins Univ.)

Los Baños-College, Laguna.

Associate Professor of Plant Physiology.

Land owner.

GHOFULPO, TEODORO G.

107 Monterey St., Gilroy, California, U.S.A.

Occupation not reported.

LABAYEN, SEGUNDO D., M.S. (Audubon Sugar School)

Binalbagan, Occ. Negros.

Factory Superintendent, Binalbagan Sugar Estate.

MARQUEZ, FRANCISCO D.

Manila.

Assistant Chief, Agricultural Extension Division, Bureau of Agriculture.

Land owner.

MIRAFLORES, JOSÉ C.

Victorias, Occ. Negros.

Factory Superintendent, Victorias Milling Co.

MONTELLANO, PEDRO L., M.S. (Univ. Wis.)

Catarman, Samar.

Teacher, Catarman Agricultural School.

Land owner.

OCEFEMIA, GERARDO O., M.S. (Univ. Phil.), Ph. D. (Univ. Wis.)

Los Baños-College, Laguna.

Assistant Professor of Plant Pathology, Acting Head of Department.

OCTUBRE, FRANCISCO P.

Rosales, Pangasinan.

Assistant Agronomist, Bureau of Agriculture.

Land owner.

PANGANIBAN, ELIAS H., B.S.A., M.S. (Univ. Phil.), Ph. D. (Cornell Univ.)

Farraron, Fabrica, Occ. Negros.

Farmer.

SARMIENTO, RAMÓN O.

Batangas, Batangas.

Extension Agent, Bureau of Agriculture.

Land owner.

VELEZ, BLAS C.

San José, Mindoro.

Technical employee, Tamaraw Plantation Co.

VICENCIO, ARSENIO S.

Manila.

Agricultural Extension Agent, Bureau of Agriculture.

Land owner.

VISTA, TOMAS I., M.S. (Univ. Phil.)

Rizal, Laguna.

Farmer.

CLASS OF 1916

Master of Science

CLINTON, GUY, B.S. (Shenandoah College)

Washington, D.C., U.S.A.

Employee, Bureau of Insular Affairs.

ELAYDA, INOCENCIO, B.S.A. (Iowa State College of Agriculture)

Los Baños-College, Laguna.

Director, Extension Division, College of Agriculture.

Land owner.

Bachelor of Science in Agriculture

PAGUIRIGAN, DOMINGO B., M.É. (Conn. Agric. College)

Iligan, Isabela.

Inspector, Iligan Tobacco Station, Bureau of Agriculture.

Land owner.

Bachelor of Agriculture

BACOMO, PANTALEON U.

Cuyo, Palawan.

Teacher, Bureau of Education, Palawan.

Land owner.

BALANGUE, CORNELIO R.

Tuguegarao, Cagayan.

Agricultural Extension Agent, Bureau of Agriculture.

Land owner.

CAGURANGAN, ALFONSO B.

Iligan, Isabela.

Teacher, Bureau of Education.

Land owner.

CONSTANTINO, MARCELINO

Manila.

Assistant Agriculturist, Bureau of Agriculture.

Land owner.

CONSUNJI, GAUDENCIO

Hermosa, Bataan.

Farmer.

CRUZ, FLORENTINO F., Master Farmer (Univ. Phil.)

Lorugan Cattle Co., Bukidnon.

Cattle Rancher.

DAWIS, VICENTE M., B.S.A. (Univ. Phil.)

Los Baños-College, Laguna.

Assistant Farm Superintendent, College of Agriculture.

LEON, JOSÉ DE

Tanauan, Batangas.

Assistant Horticulturist, Bureau of Agriculture.

Homesteader.

PALAFIX, GAUDENCIO

Naguilian, La Union.

In Charge, La Union Tobacco Experiment Station.

Land owner.

CLASS OF 1917

Bachelor of Science in Agriculture

ABADILLA, FRANCISCO

Lucena, Tayabas.

Farmer.

FRANCISCO, GREGORIO M., Master Farmer (Univ. Phil.)

Santa Rosa, Nueva Ecija.

Farmer.

GUTIERREZ, MARIANO E.

Surunayau, Dulaan, Cotabato.

In Charge, Tobacco Station, Bureau of Agriculture.

Land owner.

MEDALLA, MARIANO, M.S. (Univ. Phil.)

Bacolod, Occ. Negros.

Farmer.

MENDOZA, LEOPOLDO G.

Mabatobato, Pili, Camarines Sur.

Farmer.

SARAO, FELIX B., M.S. (Univ. Wis.)

Los Baños-College, Laguna.

Instructor in Animal Husbandry, College of Agriculture.

SILAYAN, HILARION, M.S. (Univ. Calif.)

Manila.

Irrigation work, Bureau of Public Works.

Bachelor of Agriculture

CALINGASAN, TEOFILO

Malaybalay, Bukidnon.

Farmer.

EDROSO, LEON

Abulug, Cagayan.

Farmer. Administrator Somigui Farming Colony.

FLORES, SIMEON

Dumaguete, Oriental Negros.

Teacher, Provincial High School.

GOCO, ARSENIO A.

Imus, Cavite.

Farmer.

GRAGEDA, GREGORIO
Mati, Davao.
Farmer.

PASTORFIDE, DIONISIO B.
Marinduque.
Farmer.

PAULICAN, CENON
Dagumbaan Cattle Ranch, Bukidnon.
Cattle Rancher.

REYES, SIMEON
Cebu, Cebu.
Plant Inspector, Plant Quarantine Office.

VILLYAR, PAUL
Manila.
Horticulturist, Bureau of Agriculture.
Land owner.

CLASS OF 1918

Master of Science

COCANNOUER, JOSEPH A., B. Agr.
High School, Chowchilla, California, U.S.A.
Connected with a Soil Bacteria Company.

Bachelor of Science in Agriculture

BAUTISTA, PANTALEON
Malabon, Rizal.
Farmer.

TRINIDAD, JOSÉ
Manila.
Agricultural Assistant, Bureau of Non-Christian Tribes.
Land owner.

Bachelor of Agriculture

AFRICA, EMILIO A.
Sariaya, Tayabas.
Farmer.

ARAGON, VICENTE
Muños, Nueva Ecija.
Farm Superintendent, Central Luzon Agricultural School.
Land owner.

BAUTISTA, BASILIO
Alabang, Rizal.
Assistant Agronomist, Bureau of Agriculture.
Land owner.

BAYLA, ARSENIO
Madison, Wisconsin, U.S.A.
Bureau of Agriculture Pensionado (Univ. Wis.)

FESTIN, SANTIAGO

Manila.

*Inspector, Bureau of Internal Revenue.**Land owner.***MACASAET, VALENTIN**

San Ramón, Zamboanga.

*Superintendent, San Ramón Penal Colony.***MARIANO, JOSÉ**

Bigaa, Bulacan.

*Farmer.***OTANES, FAUSTINO, B.S., M.S. (Univ. Ill.)**

Manila.

*Entomologist, Bureau of Agriculture.***PAZ, ALFONSO DE LA**

Address unknown.

*Student in the United States.***QUISUMBING, EDUARDO, Ph. D. (Univ. Chicago)**

Berkeley, California, U.S.A.

*Assistant Professor of Plant Physiology, College of Agriculture, U. P. Fellow,
National Research Council. University of California. (On leave, in Calif.)**Land owner.***SAMONTE, CLARO**

Bayombong, Nueva Viscaya.

*Technical Assistant, Bureau of Non-Christian Tribes.***SANTOS, FRANCISCO B.**

Iwahig, Palawan.

*Agricultural Assistant, Iwahig Penal Colony.***SANTOS, GREGORIO**

Manila.

*Assistant Horticulturist, Bureau of Agriculture.***TEODORO, ANASTACIO, M.S. (Cornell Univ.)**

Ithaca, New York.

*Fellow, University of the Philippines in Cornell Univ.***CLASS 1919***Master of Science***SANTOS, FRANCISCO O., A.B., M.S. (Univ. Phil.), Ph. D. (Yale Univ.)**

Los Baños-College, Laguna.

*Associate Professor of Chemistry.**Land owner.**Bachelor of Science in Agriculture***CHANCO, ANTONIO R., D.D.S. (National Univ.)**

Naga, Camarines Sur.

*Red Cross Dentist.***HABALUYAS, RAMON K., M.S. (Univ. Phil.)**

Malabon, Rizal.

*Sugar Chemist, Malabon Sugar Co.***VENTURA, TRANQUILINO**

San Fernando, Pampanga.

Sugar Chemist, Pampanga Sugar Development Company.

Bachelor of Agriculture

ADRIANO, FELIPE T., M.S. (Univ. Phil.), Ph. D. (Cornell Univ.)

Los Baños-College, Laguna.

Assistant Professor of Chemistry.

Land owner.

ALCASID, EZEQUIEL

Alabang, Rizal.

Superintendent, Alabang Stock Farm, Bureau of Agriculture.

Land owner.

CABANOS, JUAN B.

Manila.

Assistant Agriculturist, Bureau of Agriculture.

COLLADO, ESTEBAN, B.S.A., M.S. (Univ. Phil.)

Los Baños-College, Laguna.

Instructor in Chemistry.

DARIO, LEONCIO

Laosag, Ilocos Norte.

Agricultural Extension Agent, Bureau of Agriculture.

DAVID, PEDRO A., B.S.A., M.S. (Univ. Phil.)

Los Baños-College, Laguna.

Instructor in Agronomy.

ESGUERRA, JOSÉ P., B.S.A. (Univ. Phil.)

Los Baños-College, Laguna.

Animal Husbandman, College of Agriculture.

ESGUERRA, JUAN D.

Aliaga, Nueva Ecija.

Farmer.

FRONDA, FRANCISCO M., Ph. D. (Cornell Univ.)

Los Baños-College, Laguna.

Assistant Professor of Animal Husbandry.

GONZALEZ, JOAQUIN J.

Apalit, Pampanga.

Farmer.

HARDER, TOMAS

Bacolod, Occ. Negros.

Crop Reporter, Philippine National Bank.

HERNANDEZ, NEMESIO

Sarunayan, Cotabato.

Agricultural Assistant, Bureau of Agriculture.

HIDALGO, VICENTE

Dumarao, Capiz.

Superintendent, Dumarao Stock Farm.

LAGO, FRANCISCO P., B.S.A. (Univ. Phil.)

Lopez, Tayabas.

Farmer.

LEANO, BENEDICTO C.

Lipa, Batangas.

Agricultural Extension Agent, Bureau of Agriculture.

Land owner.

- LIPAYON, ANASTACIO
Nelson, California.
Farmer.
- MANIO, MELECIO
San Isidro, Nueva Ecija.
Teacher, Provincial High School.
- NARABAL, TIBURCIO
Address unknown.
Student in the United States.
- NISCE, TEOFILO
San Fernando, La Union.
Farmer.
- NOGUERRA, JOSÉ
Batangas, Batangas.
Assistant Animal Husbandman, Bureau of Agriculture.
- PADOLINA, FELIPE
Lamiao, Bataan.
Agricultural Assistant, Lamiao Experiment Station, Bureau of Agriculture.
- PERALTA, FERNANDO DE, B.S.A., M.S. (Univ. Phil.)
Los Baños-College, Laguna.
Instructor in Plant Physiology.
Land owner.
- RED, FRANCISCO R.
Guinobatan, Albay.
Agricultural Extension Agent, Bureau of Agriculture.
- ROLDAN, EMILIANO F., B.S.A., M.S. (Univ. Phil.)
Urbana, Ill.
Fellow, University of the Philippines in Univ. of Ill.
- SABADO, RAYMUNDO, B.S.A (Univ. Phil.)
San Fernando, La Union.
Teacher, Provincial High School.
- SERRANO, FELICISIMO B.
Manila.
Assistant Plant Pathologist, Bureau of Agriculture.
- SULIT, VICTOR, B.S.A., M.S. (Univ. Phil.)
Los Baños-College, Laguna.
Instructor in Chemistry.
Land owner.
- TORRES, JUAN P., Ph. D. (Cornell Univ.)
Alabang, Rizal.
Plant Breeder, Bureau of Agriculture.
- VILLADOLID, DEOGRACIAS V., B.S.A., M.S. (Univ. Phil.), Ph. D. (Stanford Univ.)
Los Baños-College, Laguna.
Instructor in Entomology.
- YAP, GERMAN
Tagbilaran, Bohol.
Merchant.

CLASS OF 1920

Bachelor of Science in Agriculture

DERECHO, ANTONIO

Cebu, Cebu.

*Agricultural Extension Agent, Bureau of Agriculture.**Land owner.*

GUZMAN, ISIDORO

Cabagan, Isabela.

Teacher, Cabagan Farm School.

JURADO, MARIANO

San Fernando, La Union.

Agricultural Extension Agent, Bureau of Agriculture.

MANIO, RAMÓN V.

San Marcos, Bulacan.

Agronomist for Calumpit Sugar Central.

PADLAN, POLICARPO

Iloilo, Iloilo.

In Charge, La Paz Demonstration Station, Bureau of Agriculture.

PASGANIBAN, SIMEON

Malabang, Lanao.

*Technical Assistant in Agriculture for Province of Lanao.**Land owner.*

PAULINO, PEDRO

Lanao, Bataan.

*Assistant, Bureau of Agriculture.**Land owner.*

REYES, GAUDENCIO M.

Manila.

*Assistant Pathologist, Bureau of Agriculture.**Bachelor of Agriculture*

AFRICA, ANGEL, B.S.A., M.S. (Univ. Phil.)

Zamboanga, Zamboanga.

Teacher, Provincial High School.

CANONIZADO, MAXIMO P.

Santa Cruz, Laguna.

Teacher, Bureau of Education.

CAPINPIN, JOSÉ M., B.S.A., M.S. (Univ. Phil.)

Los Baños-College, Laguna.

Assistant in Agronomy.

CARANDANG, ATANACIO T., B.S.A. (Univ. Phil.)

Canlubang, Laguna.

Agronomist, with Calamba Sugar Estate.

CATALAN, NEMESIO A., B.S.A. (Univ. Phil.)

Los Baños-College, Laguna.

First Lieutenant, Philippine Scouts, U. S. Army. On detail as student, College of Veterinary Science.

CAZESAS, GREGORIO D.

Bago, Occ. Negros.

Field Inspector, Maao Sugar Central.

CLARA, FELICIANO H.

Manila.

Assistant Pathologist, Bureau of Agriculture.

COLLADO, ISIDORO R., B. Div. (Iliff School Theol., Denver), M.A. (Georgetown Univ.)

Vigan, Ilocos Sur.

Clergyman, Vigan Baptist Mission.

CORRALES, JOSÉ P.

Mambajao, Misamis.

Farmer.

ELAYDA, ANIANO R.

Manila.

Assistant Horticulturist, Bureau of Agriculture.

Land owner.

ESTALILLA, HILARION H.

San José, Mindoro.

Technical Employee, Mindoro Sugar Company.

FESTIN, SIMPLICIO F.

Odiongan, Romblon.

Farmer.

GOSECO, ANDRES P.

Manila.

Fertilizer Agent, Filma Mercantile Co.

Land owner.

ISIDORO, RUFINO

Manila.

Soil Analyst, Bureau of Agriculture.

JAMIAS, JULIO M.

Binalbagan, Occ. Negros.

Agronomist, Binalbagan Sugar Estate.

LABRADOR, ANSELMO F.

La Carlota, Occ. Negros.

Agricultural Assistant, La Carlota Experiment Station, Bureau of Agriculture.

LIMBO, ANASTACIO M.

Malaybalay, Bukidnon.

Industrial Supervisor, Bureau of Education.

LIZASO, JUAN G.

Bacolod, Occ. Negros.

Farmer.

LONTOK, AMBROSIO M.

Manila.

Agricultural Extension Agent, Bureau of Agriculture.

LONTOK, GREGORIO B., B.S.A. (Univ. Phil.)

Binalbagan, Occ. Negros.

Assistant Pathologist, Binalbagan Sugar Estate.

LUISTRO, FERNANDO

Isabela de Basilan, Zamboanga.

Farmer.

MACEDA, FELIX

Tagbilaran, Bohol.

*Agricultural Extension Agent, Bureau of Agriculture.**Homesteader.***MANGONON, ALEJANDRO S.**

Residence in the United States.

*Occupation and address not reported.***MARIANO, SEVERO J., M.S. (State Univ. Louisiana)**

Botica Boie, 95 Escolta, Manila.

*Fertilizer Agent.**Land owner.***MORADA, JULIAN A.**

Naga, Camarines Sur.

*Farmer.***MORADA, EMILIO K.**

Lamao, Bataan.

*Assistant Horticulturist, Bureau of Agriculture.***PALAPOX, SERAPIO M.**

Address not known.

*Student in the United States.***PUGEDA, MELQUIADES S.**

Indang, Cavite.

*Teacher, Indang Farm School.***ROJALES, PEDRO S.**

Butuan, Agusan.

*Farmer.***TOMANENG, ROMAN G.**

Los Baños—College, Laguna.

*Student, College of Veterinary Science.***VILLANUEVA, CRISPIN B.**

Cotabato, Cotabato.

*Clerk, Provincial Fiscal's Office.***VILLARAZA, MARIANO F.**

Manila.

*Inspector for Fiber Standardization Board.**Land owner.***CLASS OF 1921***Bachelor of Science in Agriculture***ALAS, TEOFILO P.**

Tayug, Pangasinan.

*Director, Tayug Institute.***CHANDRASTITYA, IANG**

Nagor Potham, Siam.

*Teacher, Agricultural Teachers' Training College.***MEDINA, MELQUIADES L.**

La Carlota, Occ. Negros

*Assistant Agronomist, La Carlota Station.**Land owner.*

MINANO, GERONIMO M.

Cebu, Cebu.

In Charge, Animal Breeding Station, Bureau of Agriculture.

PEREIRA, EUFERMIANO DE BRAGANÇA

Otorda, Goa, Salceter, Portuguese India.

Occupation not reported.

SISON, PEDRO L.

Manila.

Plant Inspector, Bureau of Agriculture.

TALEON, ALEJO T., B.S.A., M.S. (Univ. Phil.)

Los Baños-College, Laguna.

Instructor in Animal Husbandry.

Bachelor of Agriculture

ALCARAZ, FELIX

Alabang, Rizal.

Agricultural Assistant, Bureau of Agriculture.

ABESAMIS, AMBROSIO

Bayombong, Nueva Vizcaya.

In charge, Stock Farm, Bureau of Agriculture.

AGATI, JULIAN, B.S.A. (Univ. Phil.)

Ithaca, New York.

Student, Cornell Univ.

ALAS, BENEDICTO C. DE LAS, B.S.A. (Univ. Phil.)

Los Baños-College, Laguna.

Instructor in Mathematics.

ALDABA, VICTOR C.

Tanauan, Batangas.

Plant Inspector, Bureau of Agriculture.

AQUINO, DIONISIO I., B.S.A. (Univ. Phil.)

Ames, Iowa, U.S.A.

Student, Iowa State College of Agriculture.

ASUNCIÓN, RODOLFO R.

Bulan, Sorsogon.

Farmer.

BAYBAY, DOMINGO

Guinobatan, Albay.

In charge, Abaca Experiment Station.

Land owner.

BERNARDO, FRANCISCO, B.S.A. (Univ. Phil.)

Iloilo, Iloilo.

Teacher, Provincial High School.

CARAY, ELIAS M., B.S.A., M.S. (Univ. Phil.)

Basco, Batanes.

Principal, Batanes High School.

CENDAÑA, SILVERIO M., B.S.A. (Univ. Phil.)

Los Baños-College, Laguna.

Assistant in Entomology.

- DIVINAGRACIA, DELFIN, B.S.A. (Univ. Phil.)
Albay, Albay.
Teacher, Provincial High School.
- FERRER, TOMAS G.
Cabagan, Isabela.
Tobacco Inspector, Bureau of Agriculture.
- GOCO, LORENZO, B.S.A. (Univ. Phil.)
Calapan, Mindoro.
Teacher, Calapan High School.
Land owner.
- GRANO, MOISES S. DE
Butuan, Agusan.
Supervising Teacher, Bureau of Education.
Land owner.
- GUEVARRA, CAMILO C.
Indang, Cavite.
Teacher, Indang Farm School.
- JIMENEZ, ALEJO L., B.S.A. (Univ. Phil.)
Manila.
Instructor, Manila College of Pharmacy.
- LACSON, PRUDENCIO S.
Manila.
Teacher, Tondo Intermediate School.
- MANZA, ARTEMIO V., B.S.A. (Univ. Phil.)
Berkeley, California.
Student, University of California.
- MARQUEZ, SEVERO L.
Manila.
Plant Inspector, Bureau of Agriculture.
- NERIC, JUAN I.
Virac, Catanduanes, Albay.
Principal Teacher, Catanduanes Farm School.
- OBIAS, FELICISIMO C.
Pili, Camarines Sur.
Principal, Agricultural School.
- REYES, ANTONIO S., B.S.A. (Univ. Phil.)
Cuyapo, Nueva Ecija.
Teacher, Cuyapo Institute.
- REYES, RUFO
Sinoloan, Laguna
Occupation not reported.
- REYES, TEODORICO P., B.S.A., M.S. (Univ. Phil.)
Honolulu, Hawaii.
Technical Employee, California Packing Corporation.
- RICAFRENTE, QUIRINO P.
Daet, Camarines Norte.
Teacher, Provincial High School.
- RODRIGO, PEDRO A., B.S.A., M.S. (Univ. Phil.)
Los Baños-College, Laguna.
Assistant in Agronomy.

SALINAS, LEONARDO

Batac, Ilocos Norte.

Teacher, Batac Farm School.

SALVA CRUZ, SEBASTIAN R.

Magalang, Pampanga.

Teacher, Magalang Farm School.

Land owner.

SOLIVEN, FLORENCIO A., B.S.A., M.S. (Univ. Phil.)

Los Baños-College, Laguna.

Instructor in Chemistry.

UNITE, JUAN O., B.S.A., M.S. (Univ. Phil.)

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Assistant in Agronomy.

URETA, ELIGIO C., B.S.A. (Univ. Phil.)

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Instructor in Chemistry, University of Manila.

YAP, SEVERO G.

Momungan Colony, Lanao.

Agricultural Assistant, Bureau of Non-Christian Tribes.

ZABELLA, GAUDENCIO C.

Tayabas, Tayabas.

Farmer.

CLASS OF 1922

Bachelor of Science in Agriculture

BABAO, SANTIAGO

San Juan de Bolboc, Batangas.

Farmer.

BALTAZAR, EULALIO PEREZ

San Fernando, La Union.

Teacher, Provincial High School.

Land owner.

GAMBOA, FERMIN J., M.S. (Univ. Phil.)

Jaro, Iloilo

Farmer.

GONZALEZ, LEON G., A.B. (Univ. Phil.), M.S. (Univ. Phil.)

Ithaca, New York.

Fellow, University of the Philippines, in Cornell Univ.

MAGGAY, HILARIO T.

Ilagan, Isabela.

Agricultural Assistant, Ilagan Tobacco Station, Bureau of Agriculture.

Land owner.

RAYOS, CATALINO R.

Manila.

Instructor, University of Manila.

ROYECA, SIMEON G.

Lingayen, Pangasinan.

Teacher, Provincial High School.

SANCHEZ, ANTONIO C.

La Carlota, Occ. Negros.

In Charge, Animal Husbandry Work, La Carlota Station, Bureau of Agriculture.

SANTOS, SEVERINO R.

Hagonoy, Bulacan.

Principal Elementary Schools, Bureau of Education.

Bachelor of Agriculture

ABRAJANO, QUIRICO F., B.S.A. (Univ. Phil.)

San Narciso, Zambales.

Teacher, San Narciso Academy.

ALMAZAN, PASCUAL A.

San Pablo, Laguna.

Teacher, San Pablo Intermediate School, Bureau of Education.

AQUINO, SEVERINO S.

San Carlos, Pangasinan.

Occupation not reported.

BACOL, SIMEON D.

Tagbilaran, Bohol.

Teacher, Provincial High School.

BAGUI, CRISPULO G.

Batangas, Batangas.

Teacher, Bureau of Education.

BUENAVENTURA, AGAPITO E.

Cabagan, Isabela.

Teacher, Cabagan Farm School.

COLLADO, TOMAS G., B.S.A. (Univ. Phil.)

Canlubang, Laguna.

Agronomist, Calamba Sugar Estate.

CORCINO, BALTAZAR A.

Mambusao, Capiz.

Farmer.

DADUFALZA, TOMAS D., B.S.A. (Univ. Phil.)

Bayombong, Nueva Vizcaya.

Teacher, Provincial High School.

ESGUERRA, FELIX M., B.S.A. (Univ. Phil.)

Cotabato, Cotabato.

Teacher, Cotabato Farm School.

ESTIOKO, ROMAN P., B.S.A. (Univ. Phil.)

Los Baños-College, Laguna.

Assistant in Plant Physiology.

ESTRADA, ALBERTO A., B.S.A. (Univ. Phil.)

San Fernando, Pampanga.

Teacher, Provincial High School.

FRIGILLANA, GENEROSO R.

San Carlos, Pangasinan.

Principal, San Carlos Farm School.

HERNAIS, PEDRO R.

Baguio, Mt. Province.

Teacher, Benguet High School.

HERNANDEZ, BASILIO, B.S.A. (Univ. Phil.)

Manila.

Assistant Librarian, Bureau of Science.

LASERNA, ERNEDO L., B.S.A. (Univ. Phil.)

Santa Rosa, Laguna.

Farmer.

MAGSINO, JUAN R.

Manila.

Teacher, Lincoln Primary School, Bureau of Education.

MARILAO, VENERANDO P.

Masao, Bago, Occ. Negros.

Farmer.

MENDOZA, FRANCISCO M.

Isabela, Occ. Negros.

Manager of Hacienda Socorro.

MONCERATE, BENITO N.

San Joaquin, Iloilo.

Farmer on homestead.

NOVERO, TEOFILO F., B.S.A. (Univ. Phil.)

Los Baños-College, Laguna.

Assistant in Agronomy.

PADILLA, BONIFACIO

La Carlota, Occ. Negros.

Agricultural Extension Agent, La Carlota Experiment Station, Bureau of Agriculture.

PELINO, ANACLETO R.

Indang, Cavite.

Occupation not reported.

PEÑA, DANIEL R., B.S.A. (Univ. Phil.)

Manila.

Instructor, Far Eastern College.

PIGUING, RAFAEL M., B.S.A. (Univ. Phil.)

Berkeley, California.

Student, College of Agriculture, Univ. California.

PONCE, BASILIO F.

San José de Buenavista, Antique.

Teacher, Provincial High School.

PULGAR, GERMAN M.

Lingayen, Pangasinan.

Teacher, Provincial High School.

PUNZALAN, EDILBERTO S., B.S.A. (Univ. Phil.)

Victorias, Occ. Negros.

Assistant Agronomist, Victorias Milling Co.

ROCAFORT, ANTONIO L., B.S.A. (Univ. Phil.)

Los Baños-College, Laguna.

Assistant in Physics.

- ROQUE, DAMASO
Canlubang, Laguna.
Technical Employee, Calamba Sugar Estate.
- SAGUN, CASIMIRO B., B.S.A. (Univ. Phil.)
Muñoz, Nueva Ecija.
Teacher, Muñoz Agricultural School.
- SARMIENTO, VALERIANO M., B.S.A. (Univ. Phil.)
Lincoln, Nebraska, U.S.A.
Student.
- SERRANO, CIRIACO B., B.S.A. (Univ. Phil.)
Banban, Tarlac.
Chemist, Tarlac Sugar Central.
- SORIANO, ANTONIO M.
Lingayen, Pangasinan.
Teacher, Provincial High School.
- TELLADO, FELIX S.
Sandakan, British North Borneo.
Technical Employee, Bureau of Agriculture.
- VIADO, BASILIO O.
Indang, Cavite.
Teacher, Indang Farm School.

CLASS OF 1923

Bachelor of Science in Agriculture

- ANTENOR-CRUZ, GREGORIO J.
Hacienda Filomena, Isabela, Occ. Negros.
Farmer.
- AQUINO, EMILIO CABRERA
Pagsanjan, Laguna.
Farmer.
- BENGSON, ARTURO
Manila.
Tobacco Inspector, Bureau of Agriculture.
- CELIS, EUGENIO C.
Davao, Davao.
Teacher, Mampising Agricultural School.
- CRISANTO, JOSÉ
....., Bukidnon.
Cattle Rancher.
- CRUZ, SEGUNDO MANUEL
Pasig, Rizal.
Teacher, Provincial High School.
- JAJOJO, FELIPE M., D.V.M. (Univ. Phil.)
Biñan, Laguna.
Farmer.
- JULIANO, JOSÉ B.
Los Baños-College, Laguna.
Assistant in Plant Physiology.

LEONCIO, MARTIN O.

Cebu, Cebu.

Chemist, Government Cement Co.

MABBUN, PABLO N.

Los Baños-College, Laguna.

Instructor in Economics.

OLOFERNES, BERNABE AGERO

Cebu, Cebu.

Teacher, Provincial High School.

OPIANA, GIL O.

Manila.

Assistant Chemist, Bureau of Science.

REYES, JOSÉ CHICO

Magalang, Pampanga.

Teacher, Magalang Farm School.

ROWAN, ANASTACIO S.

Capiz, Capiz.

Teacher, Capiz Farm School.

SADORRA, NAZARIO M.

Muñoz, Nueva Ecija.

Teacher, Central Luzon Agricultural School.

TALENTO, APOLINAR S.

Baguio, Mt. Province.

Teacher, Trinidad Farm School.

TERUEL, EUSEBIO TALEON

Tigbauan, Iloilo.

Teacher, Tigbauan Institute.

TUASON, NICASIO A.

Talacag, Bukidnon.

Cattle Rancher.

ZAMUCO, CALIXTO T.

Los Baños-College, Laguna.

Assistant in Agronomy.

Bachelor of Agriculture

ACUÑA, EULOGIO M.

Indang, Cavite.

Teacher, Indang Farm School.

CARREON, FELIX D.

Binalbagan, Occ. Negros.

Technical Employee, Binalbagan Sugar Estate.

CRUZ, RAMON A., B.S.A. (Univ. Phil.)

Malabon, Rizal.

Chemist, Malabon Sugar Refinery Co.

DESEMBRANA, BASILIO D.

Mauban, Tayabas.

Occupation not reported.

- DIMAANO, JOSÉ L.
Tanauan, Batangas.
Teacher, Tanauan Institute.
- FERRER, LAUREANO G., B.S.A. (Univ. Phil.)
Alcala, Cagayan.
Tobacco Inspector, Bureau of Agriculture.
- FLORES, GERONIMO L.
Manila.
Assistant in Soils and Fertilizers, Bureau of Science.
- GAVARRA, PERPETUO A.
Naga, Camarines Sur.
Teacher, Camarines High School.
- GORDON, ALEXANDER, B.S.A. (Univ. Phil.)
Ithaca, New York.
Philippine Government Pensionado, in Cornell Univ.
- LOMIBAO, PATRICIO
San Carlos, Pangasinan.
Teacher, San Carlos Farm School.
- LOPEZ, ENRIQUE
Quingua, Bulacan.
Farmer.
- MALABANAN, PEDRO L.
Lipa, Batangas.
Farmer.
- MAMARIL, JULIAN A., B.S.A. (Univ. Phil.)
Lingayen, Pangasinan.
Teacher, Provincial High School.
- NACION, CIPRIANO C., B.S.A. (Univ. Phil.)
Lingayen, Pangasinan.
Teacher, Provincial High School.
- PAGLINAWAN, SERGIO B.
Bacaycay, Albay.
Farmer.
- PAGSOLINGAN, JUAN G.
San Carlos, Pangasinan.
Teacher, Bureau of Education.
- REVECCE, FELICIANO R.
Sorsogon, Sorsogon.
Farmer.
- RODRIGUEZ, AGUSTIN Y.
Tacloban, Leyte.
Farmer.
- SAN JOSÉ, PRIMO C.
Kudurangan, Cotabato.
Teacher, Piang Agricultural School.

SAN JUAN, JOSÉ MAÑALAC

Muñoz, Nueva Ecija.

Teacher, Central Luzon Agricultural School.

TENEBRO, MAGNO T.

Sibonga, Cebu.

Teacher, Bureau of Education.

CLASS OF 1924

Bachelor of Science in Agriculture

ALDABA, SALVADOR

Malolos, Bulacan.

Occupation not reported.

BARROS, FRANCISCO B.

Bangued, Abra.

Teacher, Bureau of Education.

CASERANO, CIRILO

Rosales, Pangasinan.

Farmer.

CAVILLERO, PLÁCIDO

Dueña, Iloilo.

Occupation not reported.

DANGUILAN, LUIS J.

Bayombong, Nueva Vizcaya.

Teacher, Bayombong Farm School.

LIMUACO, MAMERTO E.

Pagsanjan, Laguna.

Occupation not reported.

MADAMBA, ULPIANO V.

Ilagan, Isabela.

Agricultural Assistant, Ilagan Tobacco Station.

MARIANO, FILOMENO S.

Ilagan, Isabela.

Tobacco Inspector, Bureau of Agriculture.

RESANANBA, THONGDEE NAI

Korat, Siam.

Teacher, Agricultural Teachers' Training School.

TOLENTINO, ANDRES F.

Vigan, Ilocos Sur.

Teacher, Provincial High School.

TOLENTINO, RAMON P.

Los Baños-College, Laguna.

Assistant in Physical Education.

TURGANO, HILARIO M.

Basco, Batanes.

Teacher, Provincial High School.

Bachelor of Agriculture

BATACLAN, EUSEBIO A., B.S.A. (Univ. Phil.)

Los Baños-College, Laguna.

Assistant in Mathematics.

CALMA, POLICARPO C.

Pasig, Rizal.

Teacher, Provincial High School.

CASTRO, MIGUEL G.

Zamboanga, Zamboanga.

Teacher, Provincial High School.

CATAMBAY, ALEJANDRO B., B.S.A. (Univ. Phil.)

Address unknown.

Student in the United States.

ELÉRCITO, JUAN M.

Lamiao, Bataan.

Agricultural Assistant, Lamiao Experiment Station.

ENERVA, EPIFANIO

San Carlos, Pangasinan.

Teacher, San Carlos Farm School.

INATONG, SEVERINO B.

Piat, Cagayan.

Tobacco Inspector, Bureau of Agriculture.

MANUEL, CANUTO G., B.S.A. (Univ. Phil.)

Los Baños-College, Laguna.

Assistant in Entomology.

MOJARES, URBANO A.

San José, Batangas.

Teacher, Bureau of Education.

MONTEMAYOR, ZÓSIMO T.

Los Baños-College, Laguna.

Assistant in Agronomy.

OCAMPO, MIGUEL R.

Los Baños-College, Laguna.

Student, College of Agriculture

PALO, MACARIO, B.S.A. (Univ. Phil.)

Los Baños-College, Laguna.

Assistant in Plant Pathology.

PASGANIBAN, FRANCISCO C.

Surigao, Surigao.

Agricultural Extension Agent, Bureau of Agriculture.

PRONTO, JUAN R., B.S.A. (Univ. Phil.)

Iloilo, Iloilo.

Instructor, Central Philippine College.

RAYRAO, TIMOTEO M.

Bayombong, Nueva Vizcaya.
Teacher, Bayombong Farm School.

REYES, MARCIANO A.

Silay, Occ. Negros.
Technical Employee, Silay-Talisay Milling Co.

SIBAL, ENRIQUE M.

Banban, Tarlac.
Farmer.

TAN, JOSÉ P.

Lucena, Tayabas.
Clerk, Provincial Governor's Office.

TORRES, ELADIO

Batac, Ilocos Norte.
Teacher, Batac Farm School.

YANGO, CLEMENTE E., B.S.A. (Univ. Phil.)

Los Baños-College, Laguna.
Assistant in Agronomy.

CLASS OF 1925

Bachelor of Science in Agriculture

CABAILO, BENJAMIN C.

Manila.
Inspector for Fiber Standardization Board.

GAERLAN, SIXTO A.

San Fernando, Pampanga.
Teacher, Provincial High School.

GUIANG, ALEJANDRO C., B.S.A. (Univ. Phil.)

Canlubang, Laguna.
Technical Employee, Calamba Sugar Estate.

GUANZON, GETULIO

Los Baños-College, Laguna.
Assistant in Chemistry.

HAUTEA, PABLO L.

Cebu, Cebu.
Inspector for Fiber Standardization Board.

JESUS, FRANCISCO DE

Los Baños-College, Laguna.
Assistant in Chemistry.

LAGOC, SANTIAGO

Davao, Davao.
Inspector for Fiber Standardization Board.

LUZURIAGA, ANTONIO R. DE

Bacolod, Occ. Negros.
Farmer.

MAYPA, JOAQUIN L.

Malalag, Sta. Cruz, Davao.

Manager, Talas Plantation Company.

PALAD, FRANCISCO T.

Los Baños-College, Laguna.

Assistant in Chemistry.

POLO, DIONISIO D.

Baybay, Leyte.

Teacher, Baybay Agricultural School.

SEVILLA, IRINEO J.

Bago, Occ. Negros.

Technical Employee, Maa Sugar Central.

SINDHURAVEJNA, PAUL

Bang Sapan, Prachiabkirikhan, Siam.

Teacher, Agricultural Teachers' Training School.

SALAZAR, GONZALO

Victorias, Occ. Negros.

Technical Employee, Victorias Milling Co.

Bachelor of Agriculture

ABAD, MANUEL

San Felipe, Zambales.

Occupation not reported.

BAGARINO, JOSÉ D.

Bangued, Abra.

Agricultural Extension Agent, Bureau of Agriculture.

BAYAN, PATERNO, B.S.A. (Univ. Phil.)

Los Baños-College, Laguna.

Assistant in Animal Husbandry.

CARREON, PRIMO R.

Berkeley, Calif.

Student, College of Agriculture, Univ. Calif.

CRUCILLO, CORNELIO V.

Malolos, Bulacan.

Agricultural Extension Agent, Bureau of Agriculture.

CRUZ, EUGENIO E.

Address unknown.

Teacher, Bureau of Education.

CRUZ, PEDRO

Albay, Albay.

Teacher, Provincial High School.

FELICIANO, EMILIO R.

Davao, Davao.

Inspector for Fiber Standardization Board.

FELICIANO, VICTOR T.

Concepción, Tarlac.
Manager, Family Farm.

GOMEZ, ELISEO T.

Manila.
Plant Inspector, Bureau of Agriculture.

GONZALEZ, SALUSTIANO, B.S.A. (Univ. Phil.)

Los Baños-College, Laguna.
Assistant in Entomology.

KALAW, MOISES, B.S.A. (Univ. Phil.)

Los Baños-College, Laguna.
Assistant in Extension Division, College of Agriculture.

LEAÑO, JUVENCIO A.

Sandakan, British North Borneo.
Agricultural Assistant, British North Borneo Co.

LOPEZ, VICTORIANO C., B.S.A. (Univ. Phil.)

Lagangilang, Abra.
Teacher, Lagangilang Farm School.

MALABANAN, DEOGRACIAS

Los Baños-College, Laguna.
Assistant to Farm Engineer, College of Agriculture.

MALIGAYA, IRINEO

Talavera, Nueva Ecija.
Manager, Hacienda Kalipalian.

MASIBAY, PACIFICO

Zaragoza, Nueva Ecija.
Farmer.

MENDOZA, JORGE N.

Tayug, Pangasinan.
Occupation not reported.

ORTIZ, MIGUEL A.

Cebu, Cebu.
Fiber Inspector, Bureau of Agriculture.

PACIS, ANDRES

Baguio, Mt. Province.
Teacher, Trinidad Farm School.

PABLO, ALFREDO D.

Malaybalay, Bukidnon.
Teacher, Bukidnon Agricultural School.

PALISOC, ILDEFONSO

Lingayen, Pangasinan.
Teacher, Provincial High School.

PEPA, MÁXIMO E.

Davao, Davao.
Inspector for Fiber Standardization Board.

PUNZALAN, MARIANO E.

Baco, Mindoro.

Assistant, Plant Industry Division, Bureau of Agriculture.

QUIZON, PABLO Z.

San José, Mindoro.

In charge, Rat Poisoning Work, Mindoro Sugar Co.

REYES, FERNANDO

Los Baños-College, Laguna.

Assistant in Agronomy.

REYES, FIDEL M., B.S.A. (Univ. Phil.)

Los Baños-College, Laguna.

Assistant in Physics.

RIVERO, NORBERTO

Davao, Davao.

Inspector for Fiber Standardization Board.

RODRIGUEZ, EULOGIO, JR.

Montalban, Rizal.

Farmer.

SACAY, FRANCISCO M.

Los Baños-College, Laguna.

Assistant in Rural Economics.

SAGUIN, JOSÉ

Dapitan, Misamis.

Farmer.

SANTIAGO, MOISES

Montalban, Rizal.

Manager of Chocolate and Coffee Factory.

SANTOS, SIMEON

Lumbatan, Lanao.

Teacher, Lumbatan Agricultural School.

VENTURA, SERAPIO

Daan Bantayan, Cebu.

Farmer.

VILLAFRANCA, VICTORIANO

Balayan, Batangas.

Agricultural Extension Agent, Bureau of Agriculture.

VILLANUEVA, LEOPOLDO, B.S.A. (Univ. Phil.)

Los Baños-College, Laguna.

Assistant in Chemistry.

SALAZAR, LEOPOLDO G., B.S.A. (Univ. Phil.)

Louisiana Univ., Baton Rouge, La.

Student, Audubon Sugar School.

CLASS OF 1926

Bachelor of Science in Agriculture

CALVO, DIONISIO A.

1807 Oroquieta, Manila.

Assistant Physical Director, Y.M.C.A.

DRES, IGNACIO O.

Oroquieta, Misamis.

Teacher, Bureau of Education.

KHOMSON, GEORGE

Lampang, Siam.

Teacher.

PORQUEZ, PEDRO P.

Cadiz, Occ. Negros.

Teacher, Cadiz Private Academy.

RELIZ, ANGEL R.

Malaybalay, Bukidnon.

Teacher, Bureau of Education.

RETIRO, DIOSCORO V.

Capiz, Capiz.

Teacher, Provincial High School.

SOL DE VILLA, LUIS S.

Pototan, Iloilo.

Teacher, Pototan Academy.

Bachelor of Agriculture

ANDAYA, ISIDRO A.

San Carlos, Pangasinan.

Teacher, San Carlos Farm School.

BANDONG, TOMAS

Los Baños-College, Laguna.

Assistant in Agronomy.

BARBON, CIPRIANO P.

Carinugan Farm, Cagayan, Misamis.

Farmer.

BRIONES, GREGORIO R.

San Pablo, Laguna.

Teacher, Bureau of Education.

BURGOS, VICTOR

San Fernando, La Union.

Teacher, Northern Luzon National Institute.

CALMA, VALERIANO

Los Baños-College, Laguna.

Assistant in Plant Pathology.

CASTILLO, NICANOR M.

Los Baños-College, Laguna.

Assistant in Mathematics.

DAVID, EMILIO T.

San Miguel, Bulacan.
Farmer.

GARCIA, CATALINO E.

Santa Maria, Pangasinan.
Teacher, Santa Maria Farm School.

GOCO, GREGORIO

Los Baños-College, Laguna.
Assistant, Agricultural Engineering.

GONZALES, GABRIEL B.

Paornbong, Bulacan.
Land owner. Farmer.

GOSECO, FEDERICO

Honolulu, Hawaii.
Student, University of Hawaii.

JIMENEZ, MATEO D.

Los Baños-College, Laguna.
Student, College of Agriculture.

LANTICAN, SOTERO P.

Leon, Iloilo.
Teacher, Leon Academy.

MACLANG, PASTOR V.

Manila.
Student, College of Education (Univ. Phil.)

MADJUS, ISIDRO L.

Billar, Bohol.
Teacher, Billar Farm School.

MENOR, PAULINO

Davao, Davao.
Technical Employee, Bureau of Agriculture.

MERCADO, TORIBIO

Los Baños-College, Laguna.
Assistant in Agronomy.

RAMOS, JOSÉ C.

Los Baños-College, Laguna.
Assistant in Agronomy.

TAVANLAR, ELIGIO J.

West Point Academy, U.S.A.
Cadet.

TUASON, CELSO S.

Talacag, Bukidnon.
Cattle Rancher.

YASAY, EDMUNDO G.

Bago, Occ. Negros.
Land owner. Farmer.

CLASS OF 1927

Bachelor of Science in Agriculture

- ANTIPOLO, PETRONILO
San Antonio, Zambales.
Occupation not reported.
- ARNALDO, MARCELO V.
Manila.
Occupation not reported.
- BALAGTAS, AMADO N.
Los Baños-College, Laguna.
Assistant in Chemistry.
- CRUZ, AMADO J. DE LA
Silay, Occ. Negros.
Occupation not reported.
- DERECHO, CONSTANCIO G.
Danao, Cebu.
Inspector for Fiber Standardization Board.
- DURANO, ANTONIO M.
Danao, Cebu.
Occupation not reported.
- ESTAÑOL, JUAN D.
Patinogon, Antique.
Farmer.
- ETORMA, SEVERINO B.
Los Baños-College, Laguna.
Assistant in Chemistry.
- FLORES, NICOMEDES C.
Pila, Laguna.
Land owner. Copra Producer.
- FLORIDA, VICENTE T.
Sibonga, Cebu.
Occupation not reported.
- FLORITA, NUMERIANO A.
San Narciso, Zambales.
Occupation not reported.
- GOTERA, EVARISTO
Guimbal, Iloilo.
Teacher, San Nicolas Academy.
- OLIVEROS, SIMPLICIO V.
Baliuag, Bulacan.
Farmer.
- PEREYRA, PEDRO R.
Santa Cruz, Marinduque.
Teacher, Provincial High School.

VALENZUELA, PEDRO D.

Manila.

Occupation not reported.

VILLAR, ULPIANO

Isabela, Occ. Negros.

Farmer.

Bachelor of Science in Sugar Technology

GRECIA, NICOLAS D., (With Certificate)

Calamba Sugar Estate, Canlubang, Laguna.

Agronomist, Calamba Sugar Estate.

HOLLERO, BENJAMIN L., (U. P. Medalist)

Binalbagan, Occ. Negros.

Assistant Sugar Chemist, Binalbagan Sugar Central.

RIVERA, JOSÉ A.

San Fernando, Pampanga.

Technical Employee, Pampanga Sugar Development Co.

ROSALES, HERMENEGILDO P.

Isabela, Occ. Negros.

Assistant Sugar Chemist, Isabela Sugar Co.

SORIANO, FELIX S.

Bacolod, Occ. Negros.

Technical Employee, Hacienda La Paz.

Bachelor of Agriculture

ABES, LEOPOLDO P.

Papaya, Nueva Ecija.

Student, College of Agriculture.

Land owner.

ATIENZA, MAXIMINO A.

Taal, Batangas.

Student, College of Agriculture.

Land owner.

BRIONES, BUENAVENTURA C.

Barile, Cebu.

Farmer.

CALINGASAN, MARTIN G.

Canlubang, Calamba, Laguna.

Employee, Calamba Sugar Estate.

EALA, QUINTIN A.

Los Baños-College, Laguna.

Librarian, College of Agriculture.

ESPAÑOL, FILEMON E.

Los Baños-College, Laguna.

Assistant in Rural Engineering.

- GAMO, ENRICO B.
Los Baños-College, Laguna.
Student, College of Agriculture.
- INCIONG, ANTERO P.
Sto. Tomas, Batangas.
Teacher, Sto. Tomas Academy.
Land owner.
- LACUESTA, GABRIEL O.
Talacag, Bukidnon.
Employee, Tuason's Cattle Ranch.
- LINA, VELENTIN K.
Lipa, Batangas.
Land owner. Occupation not reported.
- MACASAET, EMILIO M.
Los Baños-College, Laguna.
Student, College of Agriculture.
- MEDRANA, CONSTANCIO T.
Los Baños-College, Laguna.
Student, College of Agriculture.
- MEDRANA, SANTIAGO T.
Los Baños-College, Laguna.
Assistant in Agronomy.
- MORALES, EUFRAIN M.
Moncada, Tarlac.
Manager, Family Farm.
- MUYARGAS, AGAPITO B.
Los Baños-College, Laguna.
Assistant in Rural Engineering.
- PALISOC, ELEUTERIO V.
Sandakan, British North Borneo.
Junior Agricultural Assistant, Bureau of Agriculture.
- PALLER, ENRIQUE M.
Oroquieta, Misamis.
Occupation not reported.
- PINEDA, VIRGILIO E.
Cagayan, Misamis.
Cattle rancher and farmer.
- ROBIN, PASCUAL R.
Los Baños-College, Laguna.
Assistant in Plant Physiology.
- SUMAGIT, FELIX S.
Los Baños-College, Laguna.
Student, College of Agriculture.
- TUGADE, PRIMITIVO P.
Manila.
Extension Agent, Bureau of Agriculture.
- URBINO, CORNELIO M.
Manila.
Assistant Entomologist, Bureau of Science. (Rockefeller Foundation.)

Bachelor of Agriculture in Animal Husbandry

LIMPIADO, LEONCIO M.

Naval, Leyte.

Occupation not reported.

ORDOVEZA, FERNANDO C.

Santa Cruz, Laguna.

Manager of Family Farms, Tayabas and Laguna.

PAJE, PEDRO S.

Los Baños-College, Laguna.

Farmer.

SERRANO, JOSÉ A.

Peñaranda, Nueva Ecija.

Occupation not reported.

VILLANUEVA, CEFERINO J.

San Narciso, Zambales.

Assistant on Family Cattle Ranch.

*Deceased Graduates***CLASS OF 1911**

TEMPONGKO, CLODOALDO

CLASS OF 1916

SAN MIGUEL, LUCIO

CLASS OF 1917

TUASON, DIONISIO

CLASS OF 1918

LAYOSA, PEDRO

CLASS OF 1919

LINDAYAG, GASPAR

ERESE, VALENTIN

CLASS OF 1920

RAMOS, FLORENTINO

VILLANUEVA, LEON

CLASS OF 1922

CUITIONG, RUFINO

RODIS, FILOTEO

CLASS OF 1924

PURGANAN, JUAN

GOMEZ, JOSÉ

SUMMARY OF THE PRESENT OCCUPATIONS OF THE GRADUATES OF THE COLLEGE OF AGRICULTURE

Graduates with occupations agricultural in nature..... 292

Divided as follows:

Not in Gov't., 107	Independent farmers.....	75
	Employed by private concerns in agricultural enterprise.	33
Under the Gov't. service, 185	Employed by the Bureau of Agriculture.....	85
	Employed by other bureaus of government entities.....	10
	Members of the faculty of the College of Agriculture...	60
	Employed by the Bureau of Education as teachers in the Farm and Agricultural Schools.....	29
Total.....		292

Graduates with occupations not directly connected with agriculture... 88

Divided as follows:

Teachers (both in private and public academic schools).....	73
Employed by other government bureaus.....	8
Employed by private concerns in different capacities.....	7
Total.....	88

In the United States pursuing further studies.....	20
Pursuing further studies in the College of Agriculture and other colleges.....	10
Foreign graduates.....	8
Deceased graduates.....	12
In activities wholly outside of the agricultural field.....	8
Occupations not reported (mostly from the class of 1927).....	29
Total.....	88

Graduates with occupations not directly connected with agri- culture.....	88
Graduates with occupations agricultural in nature.....	292
Grand Total.....	468

ALUMNI OF THE COLLEGE OF AGRICULTURE¹

Directly connected with exploitation of land.....	191
Connected with entities engaged in fomenting agricultural development.....	314
Pursuing advanced courses in agriculture.....	30
In activities wholly outside of the agricultural field.....	8
Deceased.....	12
Occupation not reported.....	30

¹ As some graduates are connected with more than one activity, the total of these groups will exceed the number of alumni.

STUDENTS AND GRADUATES OF THE COLLEGE OF AGRICULTURE BY YEARS

Year	STUDENTS			GRADUATES			
	Total enrollment	New students	H. S. graduates	B. Agr.	B. S.	M. S.	M. F. (Honorary)
1909	55	55	5				
1910	95	51	1				
1911	175	84	5	2	1		
1912	253	105	13	4	1		
1913	294	147	18	7	2	1	
1914	380	166	6	9	1		
1915	428	194	12	15	7(a)		
1916	450	199	12	11	1	3	
1917	564	220	27	11	7	1	1
1918	366	48	36	16	2	3	
1919	462	202	27	31	3	1	
1920	528	218	37	35	8	4	
1921	622	246	37	28	7	2	
1922	673	175	31	44	9	1	
1923	648	200	42	21	19	9	2
1924	575	166	56	21	13	6	
1925	606	213	92	37	14	4	
1926	702	265	100	22	7		
1927	841(c)	356(c)	124(c)	27	21		
Totals.....				341	123	35(b)	3

a Including 2 B.S.F.

b Four obtained their B.S. degrees elsewhere.

c Registration completed August 1, 1927.



OLD COLLEGE BUILDING
First building erected on Campus



ADMINISTRATION BUILDING
Dedicated in 1911. Second building erected

Culture and Agriculture are not opposing terms. We are to believe and learn that agriculture needs no importation of goods from any other realm to provide food for the care and culture of men. As the fields of the earth bring forth all manner of fruits for the sustenance of the physical life, so also does their cultivation afford stimulus and direction to the mental and moral life. For no one can be a successful husbandman who does not follow the law of Nature, which is the law of God. "The Holy Earth" is the source of thoughts that reach the Infinite, if we listen to her teaching.

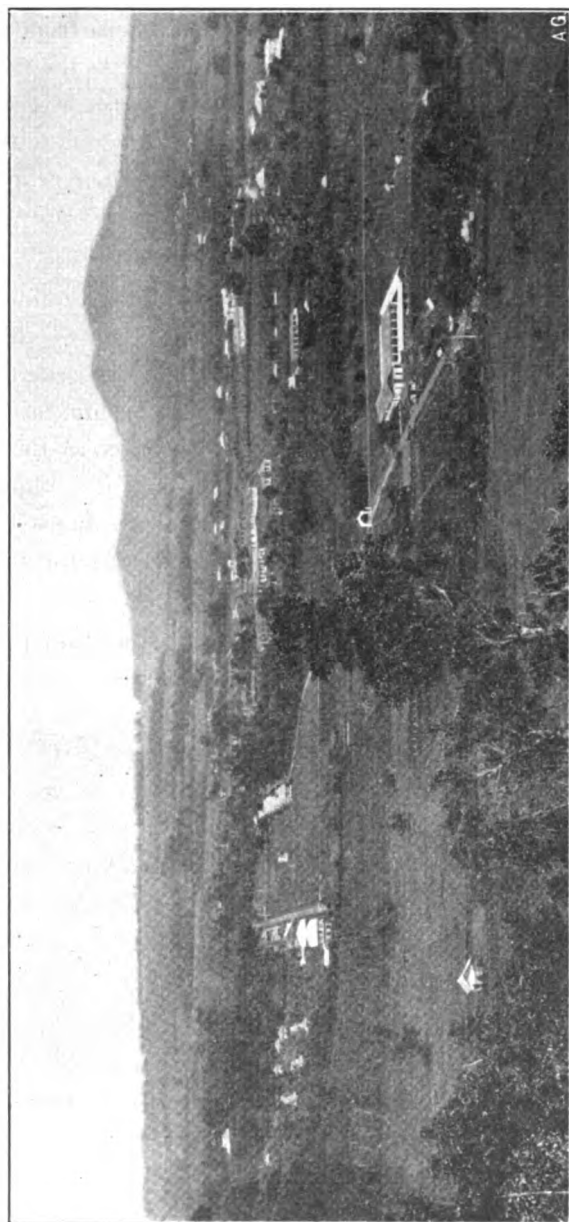
Culture is the product of thoughtfulness, the understanding of facts, the appreciation of truth. If it be said that culture involves the love of poetry, all nature is a poem. If it includes a mastery of science, the farmer must be the broadest scientist. If it calls for statesmanship, farming itself is the foundation of the state. If it demands devotion to the arts, the husbandman is the keenest craftsman of them all. And if it requires creative genius to generate culture, the master of the farm is himself a creator of value, of beauty, of influence, and of new knowledge for the world's instruction.

If the farmer of to-day is not living up to the cultural possibilities inherent in his calling, it is because he is deaf and blind to the spiritual invitations that solicit him to the mastery of forces that have produced the miracles and the wisdom of the ages. For most of us culture must take root in vocation, it can not be brought from afar. But he who holds the plow may yet look off and look up. His mind may be busy with the conquest of the world. There is no enmity between culture and agriculture.

—E. W. HOWE.

The glory of the farmer is that, in the division of labors, it is his part to create. All trade rests at last on his primitive activity. He stands close to Nature; he obtains from the earth the bread and the meat. The food which was not, he causes to be. The farmer was the first man, and all historic nobility rests on possession and use of land.

—RALPH WALDO EMERSON.



THE CAMPUS FROM THE SOUTH

The Animal Husbandry plant in the foreground, with the general class and laboratory buildings in the middle distance. Dormitories and Faculty Hill to the reader's left.

OUR FARMER VANGUARD

In every body of men in every line of endeavor there are always a few in the front, a few in the rear, and the majority in between these two guards. Our alumni body is no exception to this rule or condition. Among those personally engaged in farming there is a vanguard. Many others of more recent classes are pushing forward rapidly and in due time will be in the front ranks. We here note briefly the achievements of eight of our older men and four of our younger.

Some of these men were favored by fortune from the first. Family land and aid were at their command or service when their diplomas were handed to them. This does not in any way detract from their achievement. A very limited search would find many holders of land and diplomas in these Islands who are idlers, non-producers, parasites. These diplomas, let us hasten to say, are not from the College of Agriculture.

Other men in our farmer vanguard began with only their determination and their diplomas, the only value of the diploma being the knowledge and mental training which it signified. And, it may be added, its invisible significance of the character fiber formed by the six years work it took to earn it; work, in some cases, not only for credits but for food and shelter, as some of these men were self-supporting students.

We have an alumni vanguard in science, just as worthy of mention as this farmer vanguard, but it is as incontrovertible evidence that our men are, with outstanding success, producing food and other crops basic to industry, that we here present the farmer vanguard. These men "say it with pesos," that the College of Agriculture is a direct power in the economic progress of the Philippines.

A Commercial Farmer

José Zamora, B. Agr. '11, Master Farmer (Univ. Phil.), is one of the first class to be graduated from the College of Agriculture. He is one of the few graduates who went into actual commercial farming as an independent farmer right after graduation. Belonging to a well-to-do family in Manila, he was able to start his farm business with adequate capital. He acquired a sugar hacienda in Murcia, Tarlac, grew sugar cane and produced muscovado sugar on a commercial scale. He lived on his hacienda and managed his own farm business. In this connection he was more of a "dirt farmer" than an absentee landlord, as he handled his farm labor, farm operations and the business side of the enterprise. Farming was with him a business, as such, his concern was to make a yearly profit and receive a reasonable

interest on money invested. This profit and interest the principal crops must produce. The farm must also produce the principal part of the food supply of the people living on it. In trying to accomplish this, Zamora did not content himself with following the old foggy farm routine. He took time to experiment with the essential features of his farm practice with a view to introducing improvements. He tested farm labor-saving implements and ran several tests on his soil and crop requirements. In recognition of his effort in setting an example in the adoption of a modern system of farming suited to local conditions he was granted in 1917 the honorary degree of Master Farmer by the University of the Philippines.

As the second step of his agricultural career, Mr. Zamora sold his Tarlac sugar hacienda and bought a hacienda for diversified farming in Silang, Cavite. One reason for this change was that his property in Manila required his personal attention, and with his farm as near Manila as Silang, he could attend to his Manila property and at the same time carry on his farming business. He is now developing his Silang hacienda into a plantation of fruit trees, especially mangoes and chicos and raising secondary annual crops for the Manila market.

Mr. Zamora is ever alive to the promotion of Philippine agriculture in general. He is a member of the Philippine Agricultural Congress and the Philippine Society of Technical Agriculturists where he has been quite active in the discussion and adoption of wise measures for the amelioration of the country's agricultural conditions. His interest in scientific farming as well as in the welfare of our graduates is widely recognized. He is at present the President of the College Alumni Association.

A Farmer through Thrift

Apolonio Muñoz, B. Agr. '13, was a municipal pensionado while in College. His obligations to the municipality and later to his family turned him to teaching in elementary schools for a number of years. But he, with the assistance of his industrious and thrifty wife, saved from their income and finally they went back to their home town, Ligao, Albay, with enough capital to go to farming. Mr. Muñoz raises rice; has a 80-hectare farm planted with coconuts and abaca; a 20-hectare abaca plantation; a small coconut plantation, a rice field, and a good house in town with a lot large enough for 22 coconut trees, 50 cacao trees and many fruit trees.

A Future Cattle King

Florentino Cruz, B. Agr. '16, Master Farmer (Univ. Phil.), showed definitely in his College days that he has an understanding of animals that is almost uncanny, and the habit of thrift and a flair for making centavos produce pesos. Tradition tells that when he had paid his first matriculation fees at the College he had two pesos left as his only cash wealth, and

that when he left College he had a capital of about ₱300. This cash he had accumulated during his six years in College, besides supporting himself. This capital was largely the profits of his deals in poultry and pig raising on the share with people in the barrio near the College. In addition to his wages as student laborer he added to his income by renting to students a nipa house which he built. Cruz devoted little of his College days to the gayer side of life.

On graduation he did not splurge with his capital; it was laid safely away until he had added to it and gained some knowledge from experience. He found a job as animal husbandman with the Bureau of Agriculture. In a short time he went to Bukidnon as employee on a government cattle ranch. Here he began the career for which he is eminently fitted by natural traits and training.

Cruz was soon made manager of a large private cattle ranch with the responsibility of developing it along modern lines in breeding and management. In this he has made a notable success.

In addition to the freedom and authority in managing the ranch, he was encouraged by being paid a good salary and a percentage of increase in stock. He was also permitted to develop a large private ranch adjoining the company ranch.

The habits of thrift and practical economics developed in his College days, Mr. Cruz has carried to his work on the ranch. As an example, he soon had the ranch producing the food supplies for the laborers and for his own household.

The latest report from Mr. Cruz, manager, Lorugan Cattle Co. and Nellore Ranch, was that he is "managing 2,000 head of cattle valued at ₱150,000 belonging to a company, and owns himself 600 head of cattle valued at ₱80,000". So he has made a good long lap of the way to the title of "Cattle King". In recognition of this he was granted honorary degree of Master Farmer in 1923 by the University of the Philippines.

Lowering Rice Imports

Gregorio Francisco, B. S. A. '17, Master Farmer (Univ. Phil.), is one of the men in our vanguard for whom land and some capital was waiting when he received his diploma. Even so he has been no swivel chair farmer. He went at his job of making the rice land that was waiting for him do its duty. This means adapting the knowledge gained in College to his soil and the prevailing condition of the locality. He has done this with such notable success that he was granted in 1923 the honorary degree of Master Farmer by the University of the Philippines.

Mr. Francisco is distinctly a modern rice farmer. On his farm he uses threshing machines, tractors, good plows, harrows, etc. He wants for foremen men educated in agriculture. He has brought under cultivation large tracts of new land, besides improving the original inherited farm. He

has more than made two cavans come from where only one cavan came before. There is pride, there is purpose in Francisco's eye when he says "we are making Nueva Ecija the granary of the Philippines; Pangasinan's day is past".

A Colonizing Homesteader

Leon Edroso, B. Agr. '17, entered the government service as superintendent of the government's rice colony at Abulog, Cagayan, in April, 1917, and resigned in April, 1921. Upon leaving this government position, Mr. Edroso turned his attention to the development of a tract of public land of more than 200 hectares located near Macatel or Somigui, barrio of Calog of the municipality of Abulog. With the help of Antonio Baruga, a "dirt farmer" who had been living in this place since 1913, Edroso made a careful study of the agricultural possibilities of this tract of land, and he and Baruga came to the conclusion that the land was suitable for an agricultural settlement. It is generally level; is near an established forest zone; quite accessible to established communities; capable of irrigation by a gravity method from a large river; and distributed between low situations, has a fairly deep arable soil suitable for the growing of lowland rice, while higher levels are fit for the culture of upland crops.

Unable through lack of capital to lease this land from the government and develop it, Edroso decided to develop it by some sort of collective effort for the benefit of many. With this end in view, he persuaded and helped Baruga, the first settler in the place, to apply for a homestead of twenty-four hectares of the land. Later, he filed on twenty-four hectares for his own homestead. Realizing that the best possible attraction they could offer to prospective Ilocano settlers to induce them to come to a new place was a thrifty standing crop of rice, Edroso and Baruga set out to plant to rice as large an area of their homesteads as they could with their own hand work and meager resources. When the crop was on, Edroso made a trip to his home town Vintar, Ilocos Norte, to get some farm helpers for his own homestead and invite at the same time some of the more adventurous residents to visit Macatel and also to apply for homesteads. As a result of his efforts several people from Vintar came on their own account at the time of the rice harvest, and they have kept on coming every year in increasing numbers to see the place and help harvest the rice for whatever share they can get to pay part of their expenses in coming and returning. Many were so impressed with the large yield of rice and so assured by this indication that the soil is good that they not only decided to stay but encouraged others from Vintar and vicinity to come. Thus, not only the occupation of the entire tract by homesteading has been hastened, but also the development of each homestead by the additional farm help that came along with the homesteaders. Last year (1926) the settlement numbered about 200 persons, which furnished enough labor supply to begin improving

the land in some intensive way. An irrigation system for the whole tract was being constructed through the employment of communal labor under conditions agreed upon by the settlers themselves.

Edroso and Baruga are looked up to as leaders in the settlement. Edroso, however, plays the more important rôle. He has helped the settlers in locating and marking their homesteads, in preparing their applications for homesteads and in carrying on all other transactions with the government. He advises them about their farm work and leads and direct them in community affairs. He and Baruga are on the job every day in the settlement, doing their own homestead work and supervising the work on other homesteads. What Mr. Edroso hopes to accomplish as the final success of his efforts is to see the homesteaders of the settlement, through personal help, become absolute owners of the land they have developed, and in due time become prosperous and add to the agricultural wealth of the country. His work is constructive,—reveals vision. If the outcome is successful, and there is no apparent reason that it will not be, it will be a work of noble note.

A Good Farm Manager

Emilio Africa, B. Agr. '18, was first employed in a newly opened hacienda belonging to Unson Brothers in Cotabato. The hacienda consisted of over a thousand hectares of public land acquired from the government, to be developed into a coconut plantation. It was Africa's job to manage the breaking of the land with a tractor and planting it to coconut as the main crop of the plantation and growing peanuts as a catch crop to help pay the running expenses. According to one of the owners, from the first year's trial with the peanuts, they sold ₱1,000 worth of this secondary crop, which was highly satisfactory.

Later, Africa left this job and returned to Luzon. He is now manager of the large Solis Coconut Plantation in Sariaya, Tayabas. His employer expresses satisfaction and confidence in Africa's work, commending his operation and efficient business methods.

Mr. Africa has as his goal, when he has saved enough capital, a plantation of his own on what is now public land in Tayabas or in Camarines.

Developing Agriculture in Penal Colonies

Valentin Macasaet, B. Agr. '18, has specialized in making penal colonies successful agriculturally. His initial experience was as agricultural supervisor at Iwahig Penal Colony, Palawan. He found the colony importing farm foodstuffs. When he was promoted to the position of Superintendent of San Ramon Penal Farm, Zamboanga, in 1926, he left Iwahig self-sufficient in rice, corn, and other staple crops, with a surplus for the inmates of Bilibid Prison in Manila.

At the end of a little over one year at San Ramon, *El Reflector*, a Spanish newspaper in Zamboanga, published under date of May 29, 1927, the following (translated): "This is the first year the Penal Farm has more than paid expenses. There is a surplus of ₱4,485.02. It is believed that under the capable management of Mr. Macasaet, this record will continue".

Without detracting from the personal element in Macasaet's success, it may be claimed that without his training in this College, he would not have had the surpluses in the two colonies.

Mr. Macasaet says he is saving all he can and looking forward to the day when he will be on his own farm.

From Field Manager to Farmer

Joaquin J. Gonzalez, B. Agr. '19, stepped from the Commencement Day platform into the responsible position of field manager of a farm of about 4,000 hectares in Pampanga Province. Of his first year on this job he wrote five years later: "Believe me this was the most trying year I ever had in my life, for while the public looked upon me as a graduate in agriculture and one from whom much is therefore expected, I felt that I had yet very much to learn from the book of nature and from my very *inquilinos* who were working under me. I worked hard, morning and afternoon, and it took me almost a year before I felt confident that I could do something as a farmer".

When Mr. Gonzalez had gained confidence from experience, he began renting land, increasing the amount from year to year, sometimes leasing on fifty-fifty basis and sometimes on definite charge basis. His principal crops are rice and sugar cane. In both these crops Gonzalez has been a co-operator with the Plant Breeding Division of the College of Agriculture, thus definitely serving in scientific fields while actively occupied in productional operations on a fairly extensive scale.

A conservative estimate of the property, outside of that inherited, acquired by Gonzalez through his earnings in his farming enterprises, is between 45 and 50 thousand pesos. Part of this is in Sugar Centrals and Manila property. His net income from farming is about ₱9,000 a year. Besides the primary crops, sugar cane and rice, he raises corn and tomatoes.

Mr. Gonzalez expressed his gratitude to his Alma Mater in 1925 by offering the "Joaquin J. Gonzalez Medal" to the College of Agriculture graduate with the highest scholarship for the whole course. This medal is to be offered annually.

"Save and Have"

Hilario Maggay, B. S. A. '22, is an exponent by practice of the good old maxim, "A penny saved is a penny earned". He was self-supporting while a student in the College of Agriculture. When he had graduated he had some capital which he had saved from his earnings and little invest-

ments while in College. Since graduation he has been employed by the Bureau of Agriculture as Farm Adviser at Tuguegarao, Cagayan, the place of his birth. Mr. Maggay placed his nest egg of capital so wisely and has so increased it each month from savings that it, with increase and reinvested profits and income, represents property valued at ₱20,000. This property consists of 90 hectares of land—one-half under cultivation—three houses, coconut, coffee, and cacao plantations, and a fruit orchard of about 1000 trees. He has a good start in live stock, as carabaos, cows, horses, pigs, and chickens. Maggay feels that he is about ready to become his own employer and give his whole time and thought to his farming business.

A Prospective Sugar Farmer

Venerando Marilao, B. Agr. '22, supported himself during the six years he was in the College. After graduation he was lucky enough to get employment with the Philippine Sugar Association. His work took him right into the sugar industry in Occidental Negros. His job had to do with extension work. His habits of thrift of College days stood him in good stead. He saved from his wages and by 1924 he had seven hectares of rented land under cultivation. Since then he has extended his operations on rented land. He is now employed by the Philippine National Bank as cane inspector in Maa District. But he hopes to have soon accumulated enough capital so that he can give his whole time to sugar farming.

A Coconut Grower

Santiago Babao, B. S. A. '22, when he left College, stepped into a job of managing a coconut plantation for a large landowner in Batangas Province. This position he resigned when he found himself, through marriage, with two jobs—business and farming, on his hands. In agriculture he is planting a large coconut plantation.

A Good Start

Victor T. Feliciano, B. Agr. '25, on graduation assumed at once the management of the family property of 238 hectares, one-half of which was planted to rice. The other half is being cleared under his management. He is also managing the family's rice threshing machine. As manager, Feliciano's annual salary is five per cent of the entire rice crop and five per cent of the gross income of the earnings of the threshing machine and board and lodging.

With this start and his success thus far Feliciano should, ere many years, be running his own farm.



Student Dormitory



Y. M. C. A.



One of the best homes in early days



Student Cottage



Dining room, Molawin Hall

STUDENTS' LIVING QUARTERS IN EARLY DAYS (SEE CENTER FIGURE) AND THE
VARIETY PROVIDED NOW

IN ILLO TEMPORE

BY AN OLD TIMER

An enthusiastic young adherent of the Darwinian theory has characterized man as being originally a crocodile's embryo that had turned crazy. Of course much depends on one's idea of what is crazy. For instance, fifteen years ago, when I enrolled as freshman in the College of Agriculture, which had first opened its doors to students two years before, everybody in my home town, including my own parents, regarded me as a fool. I am not sure that they have changed their minds much since then. They could not see why I chose an agricultural course. "If it is only to plant cowpeas, you do not have to study that in college. I can teach you how right here," advised an unschooled farmer acquaintance derisively.

The truth was that I myself was at a loss to explain why I entered this College. Any way, many of the things we do will not stand very close scrutiny. I had been enrolled in the first-year preparatory medical course in the College of Liberal Arts, when, almost before I knew it, I packed up for Los Baños where I was soon tremulously producing my credentials to Dean Copeland. That was my first meeting with the august Dean. I remember to this day my shaking knees and almost inarticulate speech, as I stood ill at ease before him, so completely overcome with awe was I in his presence. I was to learn later that I was not the only one who exhibited before him that kind of reaction.

On the "Students' Campus," as the section set aside for students to build on was then called, I found accommodation in a three-room nipa house with five other students from the Southern Islands, who had been my classmates in Manila. I was only too glad to be able to get any kind of a shelter over my head. Houses were very scarce on and near the College Campus. There were only about a dozen of them altogether. Many students had to build their own homes. True enough, bamboo could be had in any quantity just for the trouble of cutting—but this was hard work. There were no boarding houses; even the dealers that supplied food in dinner pails, and who are even now plying the same trade, belong to a comparatively more recent period. We had to prepare our own meals. Of course, we were nearly all amateurs as cooks, and many a time did we have to satisfy our hunger with rice that would have stood more adequate cooking. Near famine once occurred when money from home failed to reach my housemates for three months, due to some interruption in the southern mail service. I was the only one whose home town was comparatively easily accessible, but this proximity was not to prove an immediate and

continuous source of relief; there were six hungry mouths to feed, and the capacity of my parents' purse was much too limited to meet this demand. The fish, canned goods, and meat vendors soon gave us up as bad risks. There was, to be sure, one seller who thought she could afford to carry us on, but she dealt only in ducks' eggs. So ducks' eggs we ate for breakfast, for dinner, and for supper, every day for three months. We could not get lard on credit, so we had to be content with eating plain boiled our *pièce de résistance* during all that trying period. At the end of this ordeal, when relative prosperity finally returned to us, my companions and I suddenly developed what doctors, I believe, call idiosyncrasy against ducks' eggs; and we could not touch, much less taste, one for a long time thereafter.

I have not spoken of bathrooms; there were none in those days. These beautiful white concrete structures here and there on the Campus, where you simply turn the handle and enjoy a refreshing shower bath are modern innovations. The handy Molawin Creek answered this purpose in my student days. Indeed, that creek, which nowadays serves practically no other use than to be shown to visitors as one of Nature's most lovely spots and as a prolific hunting ground for interesting zoölogical and botanical specimens—and, incidentally, a veritable cornucopia of mosquitoes that infest the College Campus—at one time played a much more important rôle in the life of College of Agriculture students. Our cooking and drinking water, and even water used in chemical and other laboratory experiments, had to be carried up in pails over steep banks. There were no bridges to speak of and muddy footpaths led from the Students' Campus to the laboratories. When the creek was flooded, classes frequently could not meet.

Most of the first professors had been originally American teachers in the Bureau of Education or technical employees of the Bureau of Agriculture. Later, reinforcements came by importation from the United States. One of these earlier arrivals was Professor Baker. I distinctly recall his coming. There was first a big load of baggage, piled high up on a carabao cart which stopped near the main stairway of what is now called Temporary or Old College Building. On top of the baggage pile sat a dusky, but tolerably pleasant featured, young man, whom I later learned was Julian Valdez, the Professor's Cuban collector. The cargo consisted mainly of pamphlets, books, insect boxes, and, I believe, an ancient typewriter, a wash basin, and a couple of folding cots. These articles were brought up into one of the upper rooms of Old College Building, which Professor Baker used for a while as a combination living quarters, research laboratory, and class room.

We were soon taking courses under him and we had free access to this room. One day the Professor happened to be out somewhere. A classmate of ours noted a razor invitingly near a handy mirror on an empty packing box, which served as a table. Instinctively he began to feel his upper lip and soon was indulging in the luxury of a shave. Unfortunately, however, familiar footsteps and voice of the owner of the razor was heard

most inopportuno outside the room. Each student hurriedly sought less incriminating positions and pretended to be busily poring over the pamphlets. Among their number was one with an asymmetrical upper lip, one side of which was neatly cropped while the other bore bristly remnants of a couple of weeks' previous neglect.

Times have changed. "The old order changeth, yielding place to new." Progress has left, and is continuing to leave, its earmarks everywhere on the College grounds and in the College buildings. Elsewhere in this number of the *AGRICULTURIST* may be found listed some of the most noteworthy advances to date. We are steadily growing and, let us trust, improving. Time alone can tell how far we will reach in another fifteen years. But old timers will always relish looking back to those earlier years and pointing out to younger men the keener struggles their College went through and the bigger obstacles that had to be surmounted. The writing of this article is one example of this excusable tendency. Also, were Dean Baker approached by some enthusiastic young professor with rosy dreams of building up a well appointed laboratory that will have facilities as up-to-date as those he saw during his pensionado days in the United States, the Dean's answer will vary little: "Time was when I had to start on a packing case for a table and an empty kerosene box for a chair." And invariably that will end the argument. Since discretion is the better part of valor, the young professor finally decides he might as well change the topic, or, better yet, withdraw.

Not for us the delectations sweet.

Not the cushion and the slipper, not the peaceful and the studious,
Not the riches safe and palling, not for us the tame enjoyment,
Pioneers! O Pioneers!

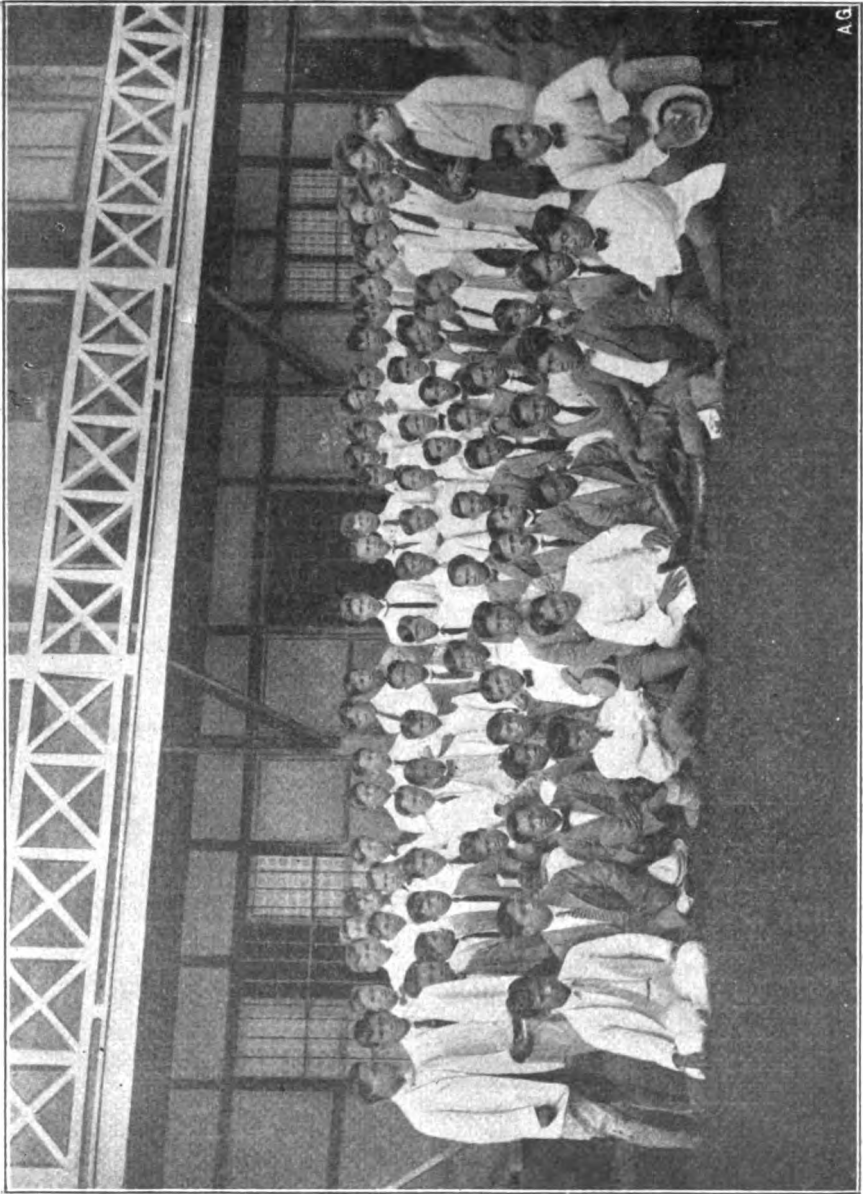
Do the feasters gluttonous feast?

Do the corpulent sleepers sleep? Have they lock'd and bolted doors?
Still be ours the diet hard, and the blanket on the ground.
Pioneers! O Pioneers!

Till with sound of trumpet;

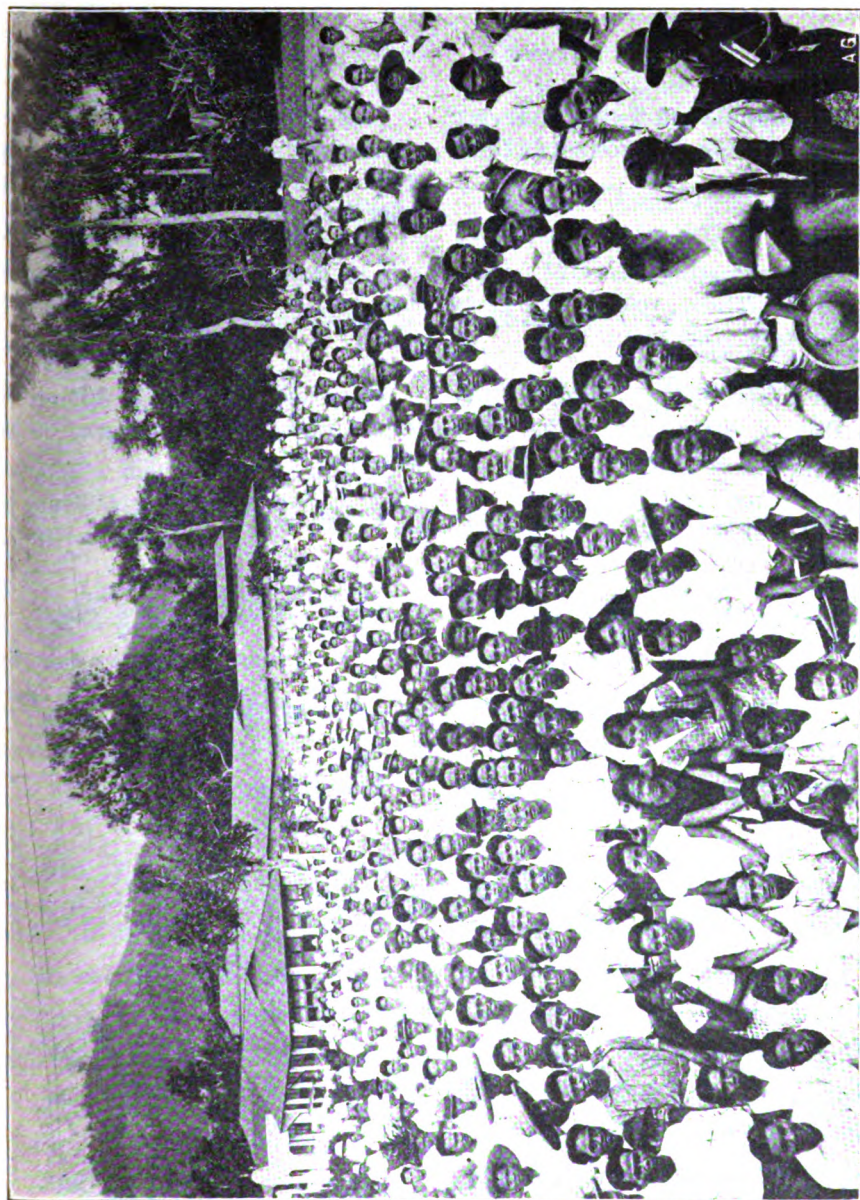
Far, far off the daybreak call—hark! how loud and clear I hear it wind,
Swift! to the head of the army! swift! spring to your places,
Pioneers! O Pioneers!

—WALT WHITMAN.



AG

STUDENT BODY IN 1911



STUDENT BODY IN 1927
All that the camera could catch

THEN

First number of THE PHILIPPINE AGRICULTURIST AND FORESTER bears date, January 1, 1911.

First graduating class (1911) numbered 3. There were 3 College of Agriculture Alumni in 1911.

There were 18 on College Faculty in 1911; 9, professorial rank; 7 instructors; 2 assistants.

There were 175 in Student Body in 1911.

There were 29 courses offered in 1911.

The area of the Campus and Farm was 74 hectares in 1911.

There were 5 College buildings in 1911.

There was no College Sugar Mill in 1911.

The Library numbered 566 volumes in 1911.

The students and faculty built their houses or sought the kindly shelter of a tree in 1911.

There were no bath rooms for students on Campus in 1911.

Homes and quarters were illumined with petroleum, candles or coconut oil in 1911.

NOW

Last number of THE PHILIPPINE AGRICULTURIST bears date, July, 1927. ("Forester" part of name was dropped in 1919.)

Last graduating class (1927) numbered 43. There are 468 Alumni in 1927.

There are 88 in 1927; 30, professorial rank; 19 instructors; 39 assistants.

There are 822 in 1927.

There are 130 courses offered in 1927.

The area is 396 hectares in 1927.

There are 61 in 1927.

There is one in 1927.

There are 7325 volumes on the stacks in 1927.

They choose their homes or quarters and buy or rent—just as in a city—in 1927.

There are 14 shower baths for students in 1927.

Electric lights perform this service in 1927.

Pails dipped in Molawin Creek and carried up its banks was the water supply system in 1911.

There was no College medical office in 1911.

There was about one kilometer of surfaced road on Campus in 1911.

College official transportation was by carabao carts in 1911.

Faculty members hiked over trails or slushed through mud from home to office in 1911.

Ice supply on the Campus was a serious problem in 1911—and for the succeeding 16 years.

There was no telephone service on the Campus in 1911.

There was no post office nearer than Los Baños, four kilometers away, in 1911.

There was no church service at College in 1911.

There was no cinematograph on Campus in 1911.

There was no store or convenient place of supply for daily needs on Campus in 1911.

A fine system supplies water on Campus—with boiled water for students—in 1927.

There is a full time College physician, trained nurse and free medicine and part time College dentist in 1927.

There are about 10 kilometers of surfaced roads in 1927.

There are 5 motor trucks and one Ford car and an ornate white service station for College official use in 1927.

Some whiz from home to office in motor cars, and the rest walk over good roads in 1927.

Ice is manufactured on the Campus and delivered in 1927—for the first time.

There is telephone service between College buildings and between College and principal Laguna municipalities in 1927.

There is a first class post and telegraph office—Agricultural College, established in 1919—on Campus in 1927.

There are both Catholic and Protestant regular services in their own chapels in 1927.

There is Cine Maquiling owned and run by College Faculty in 1927.

There is the College Co-op., a tailor shop, and a barber shop in 1927.

Members of the Faculty offered ₱5 prizes to students in 1911.

Faculty members dangle probation and extreme delinquency fates before students in 1927.

All botany students went on the famous Mount Banahao trip in 1911.

No such endurance test required in 1927.

Students came to lecture room in overalls, without coat, and often barefoot in 1911.

Students come to lecture room in similar garb in 1927.

There was a large majority of plucky self-supporting students in Student Body in 1911.

A similar group is in the majority in 1927.

There were no co-eds in 1911.

There are 18 in 1927.

There was a fine College spirit in 1911.

There is a fine College spirit in 1927.



U. P. SUGAR MILL

WHAT THEY SAY ABOUT MENDIOLA'S BOOK¹

This book, *A Manual of Plant Breeding in the Tropics*, the first technical text written by a Filipino member of our faculty, has been most favorably reviewed in technical journals. And many letters containing cordial words of praise from men actively engaged in scientific studies or interested therein have been received by Dean Baker and the author.

We give here extracts from a few of the letters.

Governor General Wood through his Secretary expressed his approval in these words:

The Governor General directs me to congratulate you upon the completion of this work which has meant so much painstaking effort on your part, and which he is sure will be a valuable contribution to the development of Agriculture in the Philippine Islands.

Dr. Leon Ma. Guerrero was the first Filipino to congratulate the author. He wrote:

It has the double merit of being a scientific and practical work, based on the experience carried out in the country with materials of the same.

With my sincerest thanks go my warmest congratulations because you have produced a text-book, which will contribute, I have no doubt about this, to the development of our agriculture through scientific methods, far from the ordinary methods actually used.

Among the reviews, it is especially gratifying that the fullest was from the pen of Dr. E. B. Copeland, first dean of the College of Agriculture. This review appeared in *Science*.

A foreword by Dean Baker explains the occasion for preparing and publishing this book. "The almost total lack of texts in the many lines of modern agricultural science, especially adapted to tropical plants, to tropical crops and to tropical conditions, makes the operation of a modern college of agriculture of full university grade in any of the new tropical countries a most difficult undertaking." Such texts had to be in preparation from the day the Philippine college of agriculture opened, in 1909. The original faculty, five Americans, might prepare one or two of them; but the job as a whole had to be tackled, indirectly, by training the men to write them. The college is now almost completely Filipino-manned, and Mendiola's is announced as the first of the series of texts from their pens.

The first forty pages are given to a very concise digest of the principles and methods of plant breeding in general. The comparative brevity of this general treatment indicates the scale of which more particular matters demand space.

Rice breeding follows with fifty pages. There has been a great deal of careful rice breeding, in many lands, during the last two decades, but this is the first comprehensive showing of tests of basic data. The necessity of such a comprehensive study of fundamentals is obvious from two facts: Where pure-line selection has been practiced most perfectly with rice, the result has been a colossal disappointment; and, while the publications on rice

¹ Mendiola, Nemesio B. 1926. *A Manual of Plant Breeding for the Tropics*. xxviii + 365 p., 54 fig. Manila: Bureau of Printing.

hybridization would fill a volume, not one authentic product of artificial crossing has come into farm use. The careful basic work of Mendiola and his students has yet to be applied to the numberless varieties of rice—above two thousand in the Philippines alone. When this is done, the results will make a book by themselves.

Sugar cane follows with thirty-three pages. The concentration of private capital in sugar production has made cane one of the most perfectly bred plants, whatever the particular local objective—yield, sucrose content, purity of sap, or resistance to particular diseases. The recent boom of the Philippine sugar industry has demanded particular attention to its problems, and the results are worthy of the effort. Seven seedling strains originating at the college have come into farm use.

The object of corn (maize) improvement receives twenty-three pages. Credited with being originally a tropical plant, maize has been bred to fit a temperate climate, until its return to the tropics is a new undertaking. Imported fine varieties, properly handled, quite regularly outyield the so-called native varieties in the dry season, but not in the wet. The immediate stimulation of yield by cross pollination is as evident in the Philippines as elsewhere; but no hybrid has yet been established which will produce in the tropics a succession of crops nearly up to the Iowa standards.

Tobacco improvement receives nineteen pages. No other crop has shown itself as dependent as this upon breeding to fit local conditions. Several places famous for their fine tobacco have undertaken in the past to prevent export of their seed, but their seed practically never produces fine tobacco elsewhere. The most of the famous tobaccos of the world have been tested at the Philippine college, and not one has proved as good there as the "Native" Cagayan. However, several hybrids have been produced, with one imported parent, of which at least one is a very superior wrapper.

Coconut breeding covers twenty pages, which suffice for the first general presentation of the basic data. For example, here is the first note of a performance record of the trees of a commercial grove, indicating that only 23 per cent. of the trees are fit sources of seed. The commonly assumed uniformity of a few strains or varieties of coconut is very soundly questioned.

Abaca improvement receives only sixteen pages, enough to show how little is known about it. The guesses at the number of varieties run from fourteen to seventy. The fact is that several species are involved, some of which are without botanical names. Mendiola points out promising methods of improvement, but most of the actual work is still to be done. And yet abaca is the most noted product of the Philippines.

Minor "crops" are covered in twenty-seven pages. These include the sweet potato, of which thirty-five native varieties have been tested at the college; cassava, perhaps the most productive crop in the world; coffee, of which the Philippines produce an excellent quality; cacao, with which they used to be credited with the finest in the world; rubber; cotton; and a number of vegetables. Briefly as these are treated, the outline of work done and needed is satisfactory for sweet potato and cassava. For rubber, it is not so, as the author is probably aware. Yams are not even mentioned.

There follow sixty-seven pages on fruit improvement, in which banana has first place. "It is probable that the largest collections of edible *Musa* are found in the Philippines," and "It is believed that many questions on hereditary phenomena may be studied and solved with this genus as material." The author proceeds to make an asset of the natural difficulty in the way of breeding this plant, outlining methods and finding room for a mass of specific data as to seedless and seedy varieties, the fertility of seed, the presence and absence of pollen, susceptibility and immunity to the wilt disease, etc. The papaya is likewise well treated. It is an especially inviting subject for the breeder because it is commonly dioecious, and every planter wants a solid field of pistillate plants. Briefer space is given to mango, lanzon, pineapple and the citrus fruits. Dozens of other fruits are mentioned or hardly more. The virginity of this field is illustrated by the discovery on the college campus of a very savory wild fruit which turned out to represent a genus new to science.

Ornamentals close the work, with particular attention to "Croton" (*Codiaeum*) and Hibiscus.

Plant breeding in the tropics is still the work of pioneers. There are great standard crops hardly better known in a scientific sense than *Hedyachras*, the new fruit tree just mentioned, and *Leptosolena*, a wild native with real advantages over Canna for the same use. Science, as we are used to its uses in the north, is just getting established in the tropics. The breeder finds there such crops as coconut, with which breeding is a slower job than he ever found it before. He finds an ancient agriculture, in which even the formation of seed has ceased in some important crops. He finds conditions for the spread of disease more perfect than temperate conditions even suggest, and must do his work over and over, as new diseases and parasites appear. Along with the ancient agriculture, he finds a new one in its genesis, in which a plant from the forest becomes over night one of the world's great crops. Into this fascinating field Mendiola has given us a guide, so usable that it stands safely without the apology of the newness of its field.

It stands out in Mendiola's book as clearly as in this review that it is the product of an institution. In the list of publications cited appear those of more than thirty of his Filipino colleagues and students. By such institutional activity the task depicted in Dean Baker's foreword has been carried on.

Wm. T. Horne, Associate Professor of Plant Pathology, University of California, wrote the author:

Professor C. F. Baker, whom I have known for a good many years, has sent me a copy of your manual of Tropical Plant Breeding. I have read it with very great interest and, although I do not pretend to be a competent authority on the more involved phases of genetic work, I feel sure that your work is sound and it should certainly be of great use to workers with tropical material as giving them a point from which to start and the gist of information already available. It should also serve as a very genuine inspiration for workers in tropical countries to go forward with this most interesting line of work, and one which always has the promise of very substantial accomplishment for human betterment. I congratulate you most heartily on this excellent piece of work.

Dr. E. W. Allen, Chief, Office of Experiment Station, Washington, D. C., had the following good words to say in a letter to Doctor Mendiola:

I note the care and thoroughness with which this has been prepared. It appears to be a timely contribution to plant breeding literature, and reflects much credit on you.

If you will permit a friendly suggestion it is that I believe the general reader of such a manual would welcome a fuller treatment of the subject of cotton breeding. Cotton is of course an important crop for the tropics and sub-tropics and its improvement has been the subject of a very large amount of investigation. The reader interested in that subject might miss reference to the work of such men as Balls, Cross, Sir Francis Watts, and others and possibly you might find opportunity for enlargement in that direction should you have a revised edition.

The "Manual" is a tribute to your training and your industry, and I thank you very much for favoring me with a copy. I shall see that a suitable note on it is made for Experiment Station Record.

Dean Russell of the College of Agriculture, University of Wisconsin, wrote:

Doctor Mendiola's book came at hand the other day. It looks like a very creditable production. It seems to me that it is highly important to have the Filipinos take up the matter of preparing distinctive tropical material in this organized form, as in this way un-

questionably they will be lifted gradually into a position where the educational work can be more satisfactorily presented than would be the case where information is based upon the use of material from foreign sources.

Dr. Stephen P. Duggan, Director of the Institute of International Education, New York City, esteems the book of practical value. We quote:

The book came the other day, I have only had a chance cursorily to read it but, if the information contained in it with reference to improving the breeding work in rice, sugar cane, corn, tobacco, abaca, and other crops, were only adopted, what a benefit to the Filipino people would result. Let me thank you for the book and for the kindly word of greeting you wrote in it. May I ask you also to convey my heartiest congratulations to Professor Mendiola, whom I remember with great pleasure.

Doctor Duggan as a member of the Monroe Commission of Investigation of educational institutions in the Philippines spent several days at the College of Agriculture in 1925.

We give in part an appreciative letter to Dean Baker from Dr. W. H. Weston, Assistant Professor of Plant Pathology, Harvard University.

The copy of Doctor Mendiola's book which you sent me arrived safely and I was very pleased indeed to receive it. I read it with great interest myself, and my approbation of it was shared by others to whom I showed it. . . .

I was greatly interested, particularly in the parts which dealt with rice, coconuts and sugar cane, and I hope that this is just the first of a series of works which shall come from the College of Agriculture under your direction dealing with equal completeness with various phases of tropical Biology in its broadest sense.

As Doctor Weston, under the United States Department of Agriculture, studied "Downy mildew of maize" in the Philippines one year and made the College his headquarters, his commendation carries a personal value.

Evelt D. Hester, formerly head of Department of Rural Economics in this College, now Assistant Commercial Attaché in American Embassy, Madrid, wrote hearty words of congratulation to his former colleague. We quote a few lines:

I have read much of your Book and find the clear outline and manner of expression extraordinarily good. As a teacher, I have been particularly bothered at times in the use of excellent texts sloppily written and poorly organized. Your book meets the teaching qualification to the last "t". I haven't a doubt about its science, although I am far from a critic on such points. I was particularly "tickled" to note the dedication to my very good friend.

We close these extracts with the kindly words of Hon. Silverio Apostol, Acting Secretary of Agriculture and Resources, Manila:

I congratulate you sincerely for this signal contribution to science. I have not yet read all the book, but I am sure of one thing: that it is the first book of the kind ever written in the Philippines.

The cordial approval expressed in reviews in British Journals is most gratifying. Two reviews follow.

From *Tropical Life*, London:

The author of this book tells us that his aim has been to provide students with a text-book in the study of the methods of tropical plant breeding, and at the same time to provide

a reference for the investigation of plant-breeding as an art or as a profession for any one who wishes to practice it. In this issue we can only say that the book is divided into thirteen chapters, of which Chapter V discusses rice-breeding, Chapter VI sugar cane, and then follow other chapters on maize, tobacco, coconuts, abaca, or Manila hemp, whilst Chapter IX discusses the minor crops, in which we are rather amused to see that coffee, rubber and cotton are included, whilst banana and fruits generally occupy Chapter XI, and ornamental plants fill the last section of the book, which concludes with an excellent bibliography and a very full index. Here we notice that with Manila hemp, such questions as its adulterations and the causes of low yields are discussed, whilst its cultivation in Malaya is touched upon, and the questions of varieties fairly fully dealt with. Bananas occupy such a considerable space and cover the ground so fully that we cannot do more than mention the fact. With cacao, its improvement, self-fertilization, viability in yield and other matters are discussed. Considering the importance that the coconut industry has assumed in the islands, the space given up to this crop is not excessive, but it is quite a lot to tell us, and those who wish to improve the quality of their nuts and increase the yield may find much that is useful within the pages given up to that subject; or even, if they do not find exactly what they hoped to meet with, what the author has to tell us should enable them to set off along the right path to learn what they wish to know from others.

Our readers out in the East will probably turn to the rubber section first; this covers pp. 217 to 227, and considering the small space devoted to it has quite a lot of information tucked away in its headed paragraphs, whilst the same can be said of sugar-cane and tobacco. Altogether we have before us a very useful book for reference, an excellent stepping stone for study and experimental work on the subject. With the help of such a book both the student and the actual planter should go far to improve the quality of his crop and increase the yields.

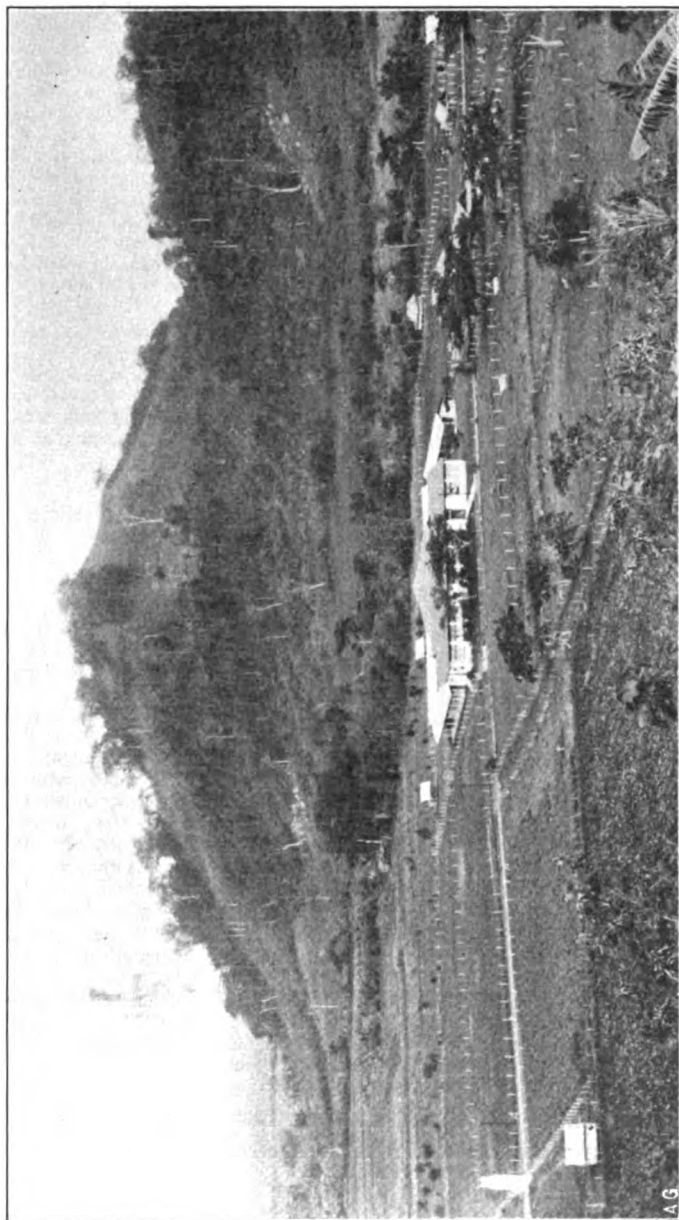
From The Bulletin of Miscellaneous Information, Royal Botanic Gardens, Kew:

A Manual of Plant Breeding in the Tropics. This volume constitutes, as pointed out in the foreword, the first of a series of agricultural science texts for use in the Philippines and in the Tropics, prepared by the College of Agriculture of the University of the Philippines. The first few chapters are devoted to the general principles of and the methods employed in plant breeding, after which a special chapter is devoted to the genetics of each of the main crops of the Philippines, such as Rice, Abaca (Manila Hemp), Sugar Cane, Maize, Tobacco and Coconuts. This is followed by a general account of the improvement of minor Philippine crops, which include Cassava, Coffee, Rubber, Cacao, Cotton, Sweet Potato, and others. In addition to crops, fruits and ornamental plants are dealt with. Under the former heading interesting accounts of recent work on banana and pawpaw (*Carica Papaya* L.) are given; other tropical fruits, including citrus, are dealt with in less detail. In the discussion on ornamental plants, work done on the various ornamental *Hibisci* receives special attention, and interesting information on the production of new seedling varieties of the common croton (*Codiaecum variegatum* (L.) Blume) and on the results of Rosal (*Gardenia florida* L.) breeding in the Philippines is included.

The book, consisting of 265 pages with numerous illustrations, should be extremely useful to all engaged in plant breeding work in the Tropics. For though intended primarily as a student text-book the field covered is so wide, and the most recent information concerning many of the crops is presented in such detail, that the book is likely to have a far wider range than that claimed for it by the author. As tropical plant breeding is dealt with exclusively the work is quite one of the pioneers of its kind, and should be appreciated as a botanical and agricultural text-book for use in colleges throughout the Tropics. A useful bibliography is incorporated at the end of the work.

The Philippine Bureau of Education recommends the book to supervisory officials and administrators as a book on vocational education with the following comment:

The book is adapted for use in the Philippines. It is written in clear and simple language and contains numerous drawings and illustrations, making it suitable for elementary school teachers.



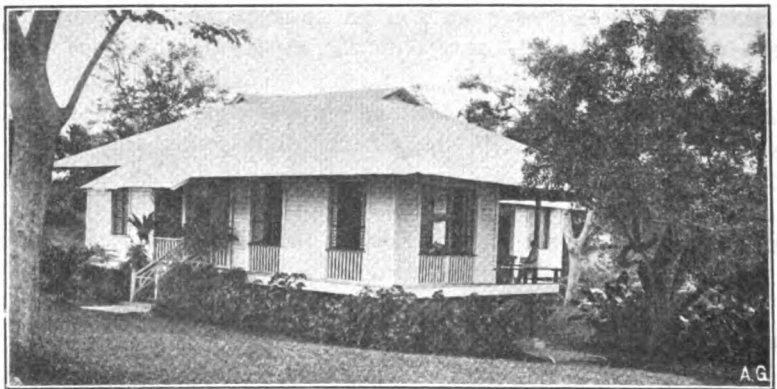
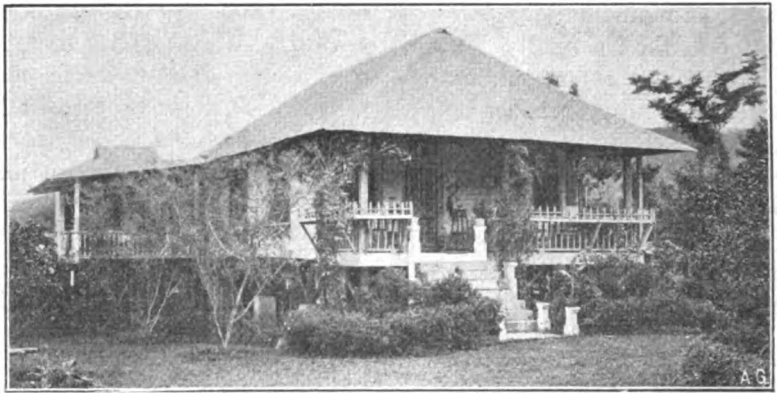
THE ANIMAL HUSBANDRY PLANT
A cogonal six years ago

FROM COGONAL TO TEACHING PLANT

Six years ago the area now occupied by the Animal Husbandry Department plant was a *cogonal*. The plate on the opposite page gives some idea of the transformation that has taken place on this area since 1921. This plant is largely self-developed. Many of the buildings and the other improvements have been made possible through the Revolving Fund created about the middle of 1923. With this fund the department has been able to build and add equipment out of earnings in much the same way as an industrial plant expands. The hog barn which burned down and was rebuilt in 1924 and the main building built in 1922-23 were constructed with funds appropriated by the University. The butcher house, feed and implement barns, dairy barn, dairy room, public breeding hog house (not shown in picture), horse stables, poultry brooder house, poultry laying house (not shown in picture), two semi-permanent paddock sheds, semi-permanent shed for stock scales, one ton ice plant, bridge across Bo-ot Creek (under construction, not shown in picture), foreman's residence (not shown in picture), were built with money from the Revolving Fund. The poultry laboratory, Animal Husbandry Gate, and replacement of temporary fencing with permanent fence of concrete posts and woven wire were partly paid for from the Revolving Fund.

Explanation of plate on opposite page

The picture gives a bird's eye view of the central animal husbandry plant showing about 5 hectares of the 150 hectares land of the department, most of which is in improved natural pastures, partly shown in the right background. The large group of buildings consists of the office and classroom building with incomplete right wing. The central ell is the stock pavilion. The row of buildings forming a quadrangle with the main building are the horse, work cattle, dairy cattle, milk room, and feed and implement barns. The two buildings at the right, almost hidden by the spreading acacia trees, are the hog barn and butcher shed and ice plant. The smaller structures are semi-permanent paddock sheds. The structure which appears as a white column at the left is the Rancher's Club memorial arch. All fields and paddocks are permanently fenced and partitioned into standard areas suitable for experimental plantings.



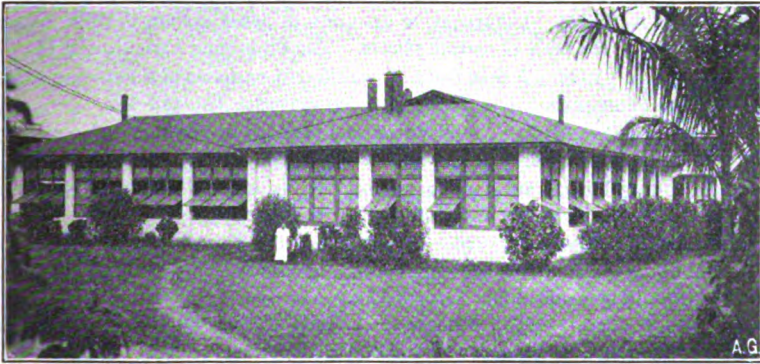
FACULTY HOMES

The early day type of house and present type. At top of page, Dean Copeland's home, third house built on Faculty Hill. Still a faculty house, the only one left of the first trio.

PUBLISHED CONTRIBUTIONS FOR THE COLLEGE OF AGRICULTURE

This list is grouped under the nine departments in the College. The list does not include all articles published in *THE PHILIPPINE AGRICULTURIST*, only those by authors who were on the College faculty at time of publication or when material for article was collected.

In arranging this list, authors, with a very few exceptions, when members of faculty, are placed under the department with which they are connected irrespective of the subject matter of the article. Contributions by students, which for the most part are graduating theses, are placed with the department under which they were prepared. The authors are grouped alphabetically, and contributions by each arranged chronologically.



Agricultural Chemistry Laboratory

There are altogether 789 contributions, four being books, and thirteen circulars, five of which are reprints of articles. By a rough estimate there are 8,400 pages.

DEPARTMENT OF AGRICULTURAL CHEMISTRY

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- CARAY, ELIAS M. 1924. Isolation and identification of some of the sugars in copra meal and coconut water. *The Philippine Agriculturist* 13: 229-254. *Pl. 1-3.*
- CLEMENTE, LEOPOLDO SUDANO. 1918. A study of Dioscorea with starch determinations and cooking tests. *The Philippine Agriculturist and Forester* 6: 230-246.
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- DE JESUS, FRANCISCO. 1927. The vitamin B content of some Philippine fruits and vegetables: III. *The Philippine Agriculturist* 15: 533-546. *Charts 1-4.*
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- DERECHO, ANTONIO. 1921. A biological study of copra meal. *The Philippine Agriculturist* 10: 45-54. *Charts 1-8.*
- GAERLAN, SIXTO A. 1926. Comparative amounts of gases carbon dioxide, oxygen, and nitrogen found in the body of certain plants. *The Philippine Agriculturist* 14: 557-567.
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- LABAYEN, SEGUNDO DIAZ. 1915. Sugar manufacture at the Calamba Sugar Estate. *The Philippine Agriculturist and Forester* 4: 92-98.
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- PANGANIBAN, ELIAS H. 1915. A study of nitrification in Philippine soils. *The Philippine Agriculturist and Forester* 4: 81-91.
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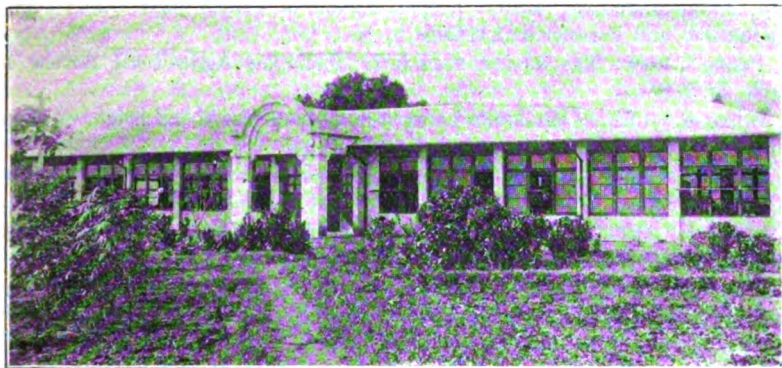
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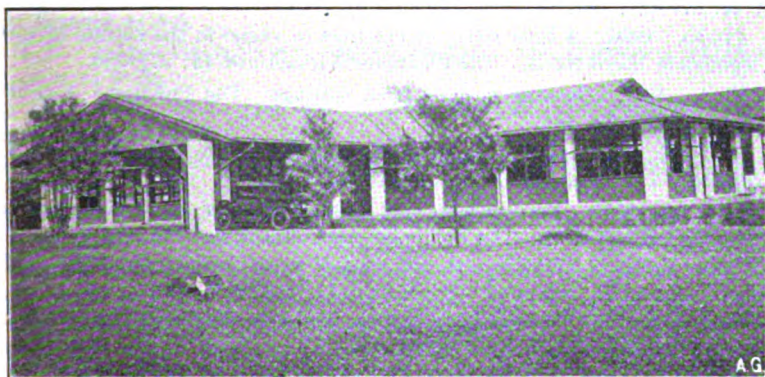
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Entomology-Plant Pathology Laboratory

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THE LAST RITES FOR OUR DEAN

Simplicity and dignity marked the last services for our well-loved Dean. On July twenty-three his body was brought back to the College he served so ably and loyally. At the town of Los Baños the faculties and students of the three associated colleges met the hearse and followed their loved Dean over the four kilometers of road to the Campus. The road he had ridden over so many hundreds of times in the years of his work for and with us in the College. It was a stately coming home. The casket was borne to the Auditorium which loving hands with palms and flowers had made ready. Here, under guard of cadets and honor guards from the faculty, Our Dean lay in state through the evening and night.

The funeral services Sunday morning, July twenty-four, were conducted by Doctor Hamilton and Reverend Bausman of the Protestant College Church. The hymns were "Jesus Lover of My Soul" and "My Faith Looks up to Thee" and Miss Manahan sang "Saved by Grace". Doctor Hamilton's address was that of a friend talking to friends of the personal life and power of Our Dean, Our Friend—who lay so silent in the hall where he had so often made fervent appeals for the highest standards of life and service.

In early afternoon, followed by many cars filled with sorrowing faculty members and delegations of students, Our Dean, covered with masses of the flowers he knew and loved so well, left for all time this College Campus so dear to him. The funeral services in Manila on this Sunday afternoon were in the Union Church. The service, as at the College, was the simple Presbyterian ritual. The hymns sung were "Lead Kindly Light" and "Crossing the Bar". The organ prelude was Grieg's "The Death of Ase". Doctor Rodgers, an old friend of the Dean, and Doctor Cook, pastor of the Union Church, conducted the services. Doctor Cook in his address spoke especially of the Dean's life of great unselfish service. "Dean Baker is the greatest gift of America to the Filipino" was his final tribute.

After the service the casket was taken to the National Funeral Parlors. On July twenty-five the body was cremated. This was in accordance with the wish of the Dean.

On August five in the morning in the College Auditorium, Memorial Services were held. Palms and flowers made the familiar hall a fitting place in which to speak in memory of Our Dean. On the platform was

unveiled a bust of Dean Baker, which had been completed some weeks before by Mr. Villaluz, for Doctor Gonzalez. On the pedestal was a very lovely wreath of roses and a leaf of the sacred palm. No tribute could more perfectly express understanding esteem than a large butterfly wrought of flowers placed near the pedestal of the bust. This was the work of Mr. Dawis of the Agronomy Department. It was exquisitely beautiful.

Those who spoke in memory of Our Dean were Doctor Roxas and Doctor Gonzalez of our faculty, Professor Cuzner of the Forest School, Dean San Agustin of the College of Veterinary Science, Mr. Marcelo Peña, President of the Student Body, Mr. Hidrosollo of the Board of Regents, and Dean Bocobo, Acting President of the University. The music, under the direction of Professor Roa, was the organ prelude, "The Death of Ase"; Massenet's "Élégie" was sung by Miss Manahan and Gounod's "O Divine Redeemer" by Mrs. Lopez. The hymns sung were "Abide with me" and "Nearer my God to Thee."

All was simple, sincere, qualities strongly expressed by the daily life of Our Dean.

CHARLES FULLER BAKER'S FINAL CONTRIBUTION TO SCIENCE

Dean Baker was unselfish to the extreme, and lived like an ascetic. As he moved from place to place, in his service in many countries and under five governments, he frequently gave away the main portion of his library and collections as they existed at the time. He would not be bothered with a library nor with collections that were static—he was interested only in what was fresh and growing.

It is recorded that he gave away a number of collections, which include the following: In 1899, to the United States National Museum, he donated a collection of about 60,000 specimens of American Hemiptera and Hymenoptera. Thirteen years later, on leaving Pomona College to come to Los Baños, not only did he present the former College with about 75,000 specimens of American insects and an herbarium of about 200,000 sheets, but he also raised the money to enable the college to provide suitable cases for the herbarium.

After coming to Los Baños and developing the work here, he gave liberally of his collections to our College. In 1921 he presented to the Department of Plant Pathology a collection of some 15,000 Malayan fungi. In the following year he gave our Department of Botany an herbarium of about 5,000 sheets of Malayan plants.

He at one time made modest mention of "numerous lesser contributions to many institutions" which certainly includes in the total an immense quantity of material. In addition to all this there are probably well over 200,000 specimens of mycological and entomological material which have been donated to his long list of collaborators.

There is no record of the total amount of money which he sent in the form of United States paper currency every month during several post-war years to his collaborators in Central Europe. It must have been large, for at one time he told me that he was making it a practice to send over half of each month's salary.

The final chapter of his list of donations we find written in his will: His main collection, which is entomological, goes to the United States National Museum, Washington, D.C. This collection comprises over 1,450 Schmidt cases of insects, arranged in perfect order and kept in marvellously good condition. This collection is to remain in his house, exactly as he left it, until an experienced packer arrives from the Museum to pack and ship it. Dean Baker specifies every detail of the care of the collection,

even as to when the windows of the storage rooms are to be opened and closed. Some years ago this collection was estimated to be worth ₱50,000; its value at the present day is certainly much higher, because of the constant additions.

Also to the National Museum go the very lengthy and recently completed bibliography of Indo-Malayan entomology. This manuscript exists in the form of about 100,000 cards, each bearing not only one but many even two and three citations each. These are all in his own handwriting, as he had no typewriter of his own, and seldom borrowed one. His very extensive personal correspondence was carried on in the striking large hand in which he wrote.

In addition to the above manuscripts, there are several bibliographies of Philippine entomology, as well as other manuscripts, which are to go to the National Museum, along with his correspondence and personal papers.

To the College of Agriculture he gives his entire library, which is really only a small working collection of about 200 bound books and numerous pamphlets, including many current entomological journals. Other books and publications in large numbers he had already given to our College library from time to time. The College also receives his collection of shells (Mollusca) and his small herbarium and all botanical specimens, of which there are but few.

To Dr. Leopoldo B. Uichanco of this College he leaves all the field equipment, insect nets, and tools. The bottled specimens are also given to him.

Aside from the above, there is very little property. The furniture in the house is meagre and simple. His house and lot in Los Baños town are to be sold, and the proceeds, together with the small amount due him from the University on account of leave and retirement pay, are to be devoted to the collegiate and medical education of one to whom, though having no claim at all upon him, yet he felt deeply obligated.

Thus, long after he has ceased to head this unusual and outstanding educational experiment, and long after his own fingers have ceased to work over the insects of the day's or night's collections, will his old students, fellow workers, and beneficiaries continue to use and pass on to others the fruits of a life of outstanding unselfishness and remarkable intensity of activity.

ROBERT L. PENDLETON,
Of the Department of Agronomy.

RESEARCH AND PRACTICE

Reprinted from *Tropical Agriculture*, the official journal of the Imperial College of Tropical Agriculture, Trinidad, B. W. I.

In a recent issue of *The Times* there appeared an article on "Science and Farm Practice" which deserves the careful consideration of everyone engaged in tropical agricultural research and practice. It is emphasized that progress must inevitably be slow and the accruing results uncertain unless the two great forces in agriculture operate in harmony, and are mutually helpful. Agriculturists should appreciate the intricate nature of the work that engrosses and perplexes the scientists, but it is equally essential that the difficulties of putting their teaching into practice should be recognized by the men of science. Neither side has a monopoly of the serious obstacles to progress and if the best results are to be secured both must advance towards a common meeting place where their respective difficulties can be explained and discussed from the different aspects. It is recognized that the attitude of agriculturists towards science and those engaged in it has improved, and it is certain that the average agriculturist now manifests a greater respect for science than he did in the past. This improved relationship equally reflects a change in the bearing of scientists. As a result of increased experience each side has learned more fully the difficulties of the other.

The research worker needs the sympathy and indulgence of others besides the practical agriculturist. The enlightened agriculturist indeed appreciates the obscure and involved character of the problems engaging attention in the laboratory, and recognizes that results may not be forthcoming quickly. He knows that there is no short-cut to the solution of the problems which can be tackled on the land, and those to be investigated in the laboratory are known to be at least equally intricate and delicate. It is not, therefore, in this quarter that impatience is expressed with the rate of progress of work which scientists have on hand. On the contrary the agriculturist's main complaint lies in the hasty pronouncement of results. It has too frequently happened that results issued by centres of research have failed to justify themselves in field practice. Even one failure of this kind tends to shake confidence in science and it is of the utmost importance that in the future the greatest care should be exercised in eliminating as far as possible the issue of such imperfect results. The leading centres of research have been fully cognizant of the detrimental effect on scientific

investigation which results from the publication of incompleated studies and it is largely to this that the increased respect for agriculture is due.

The premature publication of results has not always been the fault of the investigators. The chief culprits, it is alleged, have been the authorities under whose auspices the investigations or field trials have been carried out. To them must be attributed a liberal share for the barrier which has separated scientific worker and practical agriculturist. Public bodies are usually impatient for results and do not invariably realise the time required to probe unsolved problems thoroughly and draw from the information revealed deductions that will yield definite and reliable results in the field. The enlightened planter usually has a sincere sympathy, born of his own experience, with the scientist hustled for results. *The Times* correspondent refers to one "discovery" whose failure in practice was estimated by scientists engaged in the same class of work to have thrown back the teaching of research work twenty years.

The clamor for immediate results has resulted in the neglect of some of the more fundamental problems of wide application, and, ultimately, of the greatest commercial importance, for which extended investigation is essential. It is for problems of this nature that institutions such as the College are best adapted, where necessary work could be continued over a long period by relays of research workers and problems could be approached simultaneously from various aspects and the results correlated and brought to bear upon the main issue. But for the performance of such work an adequate staff and ample land are essential. At present the demands upon the College in various capacities are increasing more rapidly than its resources. This issue is quite clear. With adequate financial backing the demands can be met; without it they cannot. Without an estate where investigations can be made and tried out on a commercial scale, and without staff necessary for this work some restriction in the activities of the institution can not be avoided. The more immediate functions are expanding so rapidly that the more fundamental research work, for which the constitution of the College is peculiarly well adapted, will, in all probability, suffer most. That such should prove the case would be most unfortunate. The remedy, however, lies not with the College but with others.

Dr. Erwin F. Smith, Dean of American plant pathologists, died on April 6, 1927, at the age of 73. Extracts from his address—"Some Thoughts on Old Age"—appeared in the PHILIPPINE AGRICULTURIST, March, 1927.

PERICYMA CRUEGERI (BUTLER):
ITS LIFE HISTORY AND ECONOMIC IMPORTANCE
(NOCTUIDAE, LEPIDOPTERA)¹

HILARIO A. ROXAS

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WITH TWO PLATES

Pericyma cruegeri (Butler) belongs to the family Noctuidae, subfamily Quadrifinae (Lepidoptera). The genus *Pericyma* is practically of world-wide distribution, having been reported from the Nearctic, Neotropical, Ethiopian, Oriental, and Australian regions; but this particular species is very limited in its geographical range. It was first obtained from Australia by the collectors for the Godfrey Museum and was described by Butler (1896), as *Hcmoptera cruegeri*. W. B. Pryer found specimens of the same species in Sandakan, Borneo, and presented them to the United States National Museum (Butler, 1892). The Philippines is the third locality record for this species.²

The host plant is *Peltophorum inerme* (Roxb.) Naves (Leguminosae). This tree is indigenous in the Philippines, being found in the wild state along the seacoasts from Batangas to Negros, and on the coasts of Mindoro and Palawan. The tree is also a characteristic component of the flora of "Ceylon, through Malaya to northern Australia" (Merrill, 1912, p. 233). The distribution of the host, which is co-extensive with the pest, is a basis for the presumption that *Pericyma cruegeri* is a native of the Australian and the Malaysian regions.

As early as the middle of February, the caterpillars appear in great numbers and defoliate this common shade tree in Manila. The attack lasts until the middle of April, when suddenly the pest disappears, only to reappear at the same period the following year. These annual appearances are an intensely interesting phase in the study of this pest, as there are no marked climatic changes in the Philippines which might account for such a long period of rest (Uichanco, 1926). What causes it to remain dormant for about nine months and in what stage it passes from one year to the next have not been adequately studied.

In 1920 and 1921, two broods were observed. The first brood, which hatched about the middle of February, was not very large and only a few trees were affected. But about the middle of March, the second brood

¹ Received for publication April 19, 1927.

² The Philippine material was identified by W. Schaus, of the U. S. National Museum.

came out and the larvae attacked all trees which had not been defoliated by the first. In the meantime, the trees which had been affected by the first brood began to recover and develop new leaves which became fully formed by about the middle of April.

LIFE HISTORY AND HABITS

Eggs and egg laying. From five to eight days after emergence in captivity, the female moth begins to oviposit. The eggs are laid singly or in groups of two or three, usually near the tip of the leaflets. The eggs are loosely attached, so that probably many accidentally fall to the ground.

The egg (pl. I, fig. 1) is subspherical and has an equatorial diameter of 0.72 mm. and a length of 0.61 mm. from pole to pole. When freshly laid it is deep green and subconcolorous with the nether surface of the leaf. But as it approaches the end of the incubation period it fades to a light whitish-green color. The chorion bears thirty-two longitudinal ridges, which are arranged in pairs, the members of each pair coalescing just before reaching the polar regions.

Larvae. Under ordinary conditions, the egg hatches in from five to seven days after laying. Just before breaking out of the egg case, the larva, which measures about 4 mm. in length, is at first inactive. It is whitish green, thus resembling the color of the back part of the young shoots of *Peltophorum*. Each of the three thoracic legs is three-jointed and bears distally a pair of claws. In this instar only two abdominal prolegs are in evidence; these are located on the apparent eighth and ninth segments. The antennae are short and whitish green. The mandibles are prominent and pale yellow. Six black larval eyes are seen on either side of the head.

The larva molts four times. After ten to thirteen days it reaches a size of from 42 to 45 mm. (pl. I, fig. 2). The full-grown larva has prominent lateral markings composed of a continuous black line, a continuous thin white, a mixed white, a black and yellow, and a wide white line divided into segments by dark spots on the middle of each segment. These lateral markings are present both on the thoracic and the abdominal segments. The head is reddish yellow, and the body chalk-white on the dorsal side and dirty green on the ventral side. The thoracic legs are uniformly brown and the abdominal prolegs, now numbering three, are nearly of the same color, but conspicuously darker brown apically.

The larvae are restless and move about very rapidly, the smallest ones, about 4 mm. in length, being capable of covering a distance of 74 cm. a minute. If a caterpillar is shocked or otherwise disturbed, it suddenly drops and suspends itself by a tiny silk thread. It may either remain suspended in the air for a time or whirl about and jerk until it gets hold of an object or reaches the ground. The caterpillar has also the habit of moving down the trunk of the trees to the ground where it feels around only to come up again.

The caterpillar feeds by fastening itself on a midrib with its prolegs, grasping one side of the blade of a leaflet with its anterior legs and eating it with great rapidity. It starts along the edge, eating up a strip about 0.3 to 0.5 mm. in width without stopping until one side of the leaflet is consumed. It then commences at the other edge and repeats the process, until all or nearly all of the leaflet is devoured. This is the procedure when the food supply is scarce; when the supply is abundant, only the edges of the fresh leaf are eaten.

Prepupal and pupal stages. The full-grown caterpillar when ready to pupate remains inactive for a time; then it contracts, flexes the anterior part of its body ventrally, and starts forming a framework for its cocoon. The first step is spinning a few silk threads here and there around the place selected for pupation. The caterpillar then begins to work on this framework and the cocoon is reinforced from the inside by moving its head back and forth in all directions until the cocoon is completed³. Two or three days after it has started to spin, the larva molts for the last time, and changes into a pupa. The larva just before pupation is pale whitish green, flexed ventrally, thick, and greatly contracted (pl. I, fig. 3).

The female pupa averages 15 mm. in length and the male, 17 mm. although there is a great variation in the size (pl. I, fig. 3). The amount of food and, consequently, the size of the larva predetermines the relative size of the pupa. Owing to lack of food, the larval stage may be abridged and small pupae produced. That the size of the larvae is directly proportional to the amount of food available is seen from the fact that the pupae of the first brood, when the food supply was plentiful, were usually larger than those of the second brood when the food was scarce. The pupae are usually found between leaflets or between petioles of old leaves, but sometimes they may be found under the bark of trees, on scars left by old branches, or even between stones or wooden walls of houses. They may be either naked or surrounded by a thin coat of silk strands.

Adult. After a pupal period of from seven to eight days, the adult moth emerges. Emergence usually takes place between six and eight o'clock in the evening. The antennal cases first break away from the line on which they adhere to the wing pads and to the prothorax. The moth issues forth slowly, head first, then the legs, and finally the wings; it raises the cases of the legs and the proboscis to allow the escape of the wings and the body.

The adult, in common with all moths belonging to the family Noctuidae, is nocturnal in habit. In the day time, it is very inactive, staying in dark or dimly lighted places and flying only when disturbed. In the cages the moths gather in groups in dark corners and exhibit a decided negative

³ It appears, at least under laboratory conditions, that cocoon formation is not a very essential prerequisite to proper pupation. A larva which has finished or partly finished spinning may be deprived of its cocoon and still be able to pupate properly.

light reaction. In captivity, they seem to do well on a diet of thin sugar solution. In this way the writer was able to keep them alive for as long as eight days.

ECONOMIC IMPORTANCE

The larva of *Pericyma cruegeri* is so voracious that at certain seasons it is a real menace to *Peltophorum inerme*. The writer has not, as yet, found any alternative host species. A tree attacked may become almost or entirely leafless five to ten days after the larvae hatch out (pl. II). Yet the attack, being sudden and of short duration, is normally not fatal to the plant. The latter easily recovers and begins to form new shoots a week after the old twigs, with empty pupal skins, fall to the ground. Were it not for the natural enemies of this caterpillar and for the apparent vigor of this tree, perhaps the effect would be more disastrous.

Besides being destructive, the larva is a nuisance to the public. When the caterpillars are very numerous, they often fall on people passing under the trees. The caterpillars even get under the clothing and cause a slight itchiness and redness of the skin.

NATURAL ENEMIES

Parasites. More than one-half of the pupae of the second brood collected from the trees around the campus of the University of the Philippines in Manila in 1921 were rigid and darker than the normal pupae. These, when dissected, were found to contain not the pupae of the moth but those of a Chalcid fly, *Chalcis albotibialis* Ashmead⁴ (pl. I, fig. 5).

This chalcid is very abundant toward the end of March, during the time that the larvae of the second brood are beginning to pupate. They can be easily seen hovering around the trunk and large branches of the trees attacked by *Pericyma cruegeri*. It is at the critical prepupal stage that the parasite oviposits in the host. The moth's cocoon is thin, and is easily penetrable by the long ovipositor of the chalcid. Sometimes when the cocoon is thick the chalcid may spend ten to fifteen minutes in ovipositing. The parasitic larva, on hatching, finds itself in the midst of an abundant food supply, and developing proceeds very rapidly. During the first brood the writer found only a very few instances of parasitism; but with the second brood, about seventy per cent of the pupae were parasitized.

Other natural enemies. The fact that pupae are partly or wholly exposed makes them an easy prey to ants. More than one-fifth of the pupae collected from the shade trees around the campus of the University of the Philippines were found to contain nothing inside. They had a hole too

⁴This chalcid fly was identified by S. A. Rohwer, of the U. S. National Museum. [This parasite has likewise been frequently bred in Los Baños from pupae of the banana leaf roller, *Erionota thrax* Linn., Hesperidae.—L. B. U.]

small to have permitted the escape of either the moth or the chalcid. Thus the writer is inclined to believe that the ants were responsible, to a limited degree at least, for the mortality of the pupae.

The common rice birds, *Munia jagori* Martens (family Ploceidae), and the common thickheads, *Hyloterpe philippinensis* Walden (family Laniidae), were seen picking up the caterpillars irrespective of size. They either ate them on the spot or flew away with them in their beaks.

As noted above, the caterpillars are extremely restless, especially those between 20 to 35 mm. in length. As a result, many fall to the ground where they are picked up and eaten by chickens.

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ILLUSTRATIONS

(Mr. Juan Fontenosa, of the Bureau of Forestry, helped in the preparation of photographs. The drawing of the egg, plate I, fig. 1, was made by Mr. Felix V. Santos, Department of Zoölogy, University of the Philippines.)

PLATE I

- Fig. 1. Egg of *Pericyma cruegeri*. $\times 45$.
- Fig. 2. Larvae of *Pericyma cruegeri*, instars I, II, III, IV, and V. $\times 1.5$.
- Fig. 3. Above: Prepupa, ventrodextral view.
Below: Pupae, dorsolateral and ventrolateral views. $\times 2$.
- Fig. 4. Adults, dorsal view. Above, male; below, female. $\times 1$.
- Fig. 5. *Chalcis albotibialis*, dorsal, ventral and lateral views. $\times 4$.

PLATE II

A *Peltophorum* tree, before and after the attack. (a) Taken March 10, 1927, before *Pericyma* larvae appeared. (b) The same plant, twenty-three days later, on April 2, 1927, after the attack. The dots seen on the branches are leaflets encasing pupae.

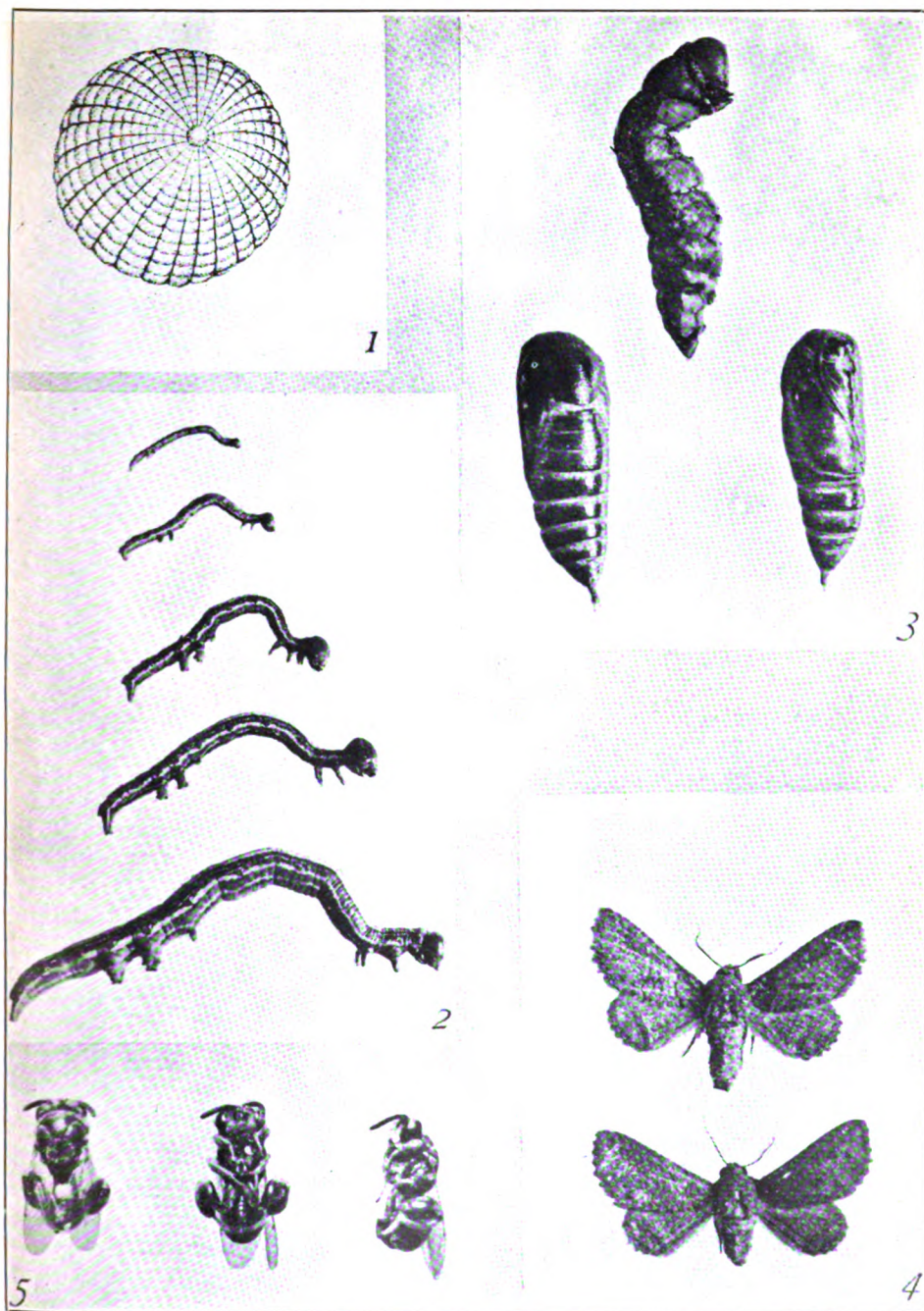


PLATE I

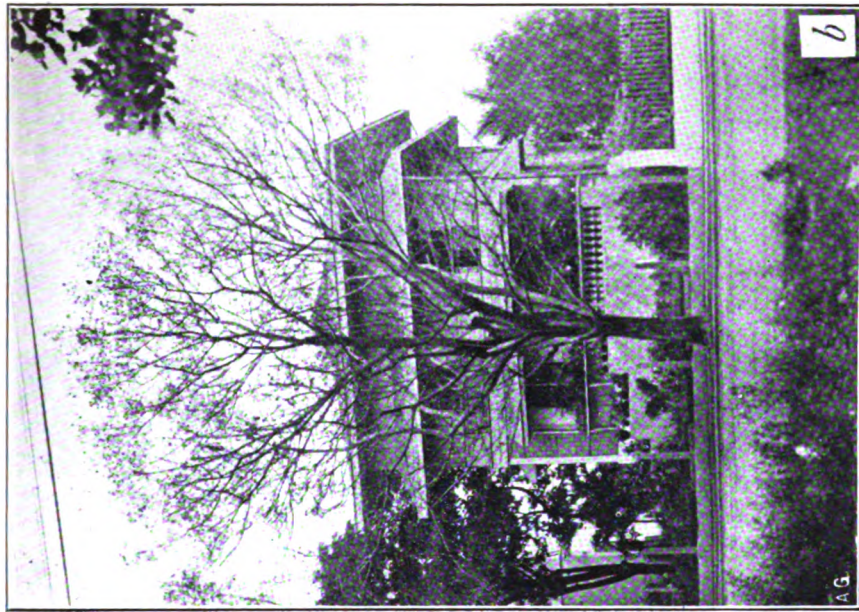


PLATE II

THE COST OF PRODUCING RICE, 1926-27¹

FRANCISCO M. SACAY

Of the Department of Rural Economics

WITH TWO CHARTS

INTRODUCTION

The knowledge of the cost of production is necessary in the successful management of any business. With reference to farming, Adams (1921) writes: "Knowledge of costs means fewer mistakes in judgment and better earning ability". Such studies are of principal interest to farmers because through understanding their cost of production they can determine the price that should be placed on their products, or the margin of profit that is obtained from the current price in the market for such products. This is of help in reorganizing the farm for better farm income and profit in the future. Farmers obtain a knowledge of the different elements of cost which they can use as a basis in studying the ways of making the farm pay more by reducing cost and increasing returns. Furthermore, facts revealed by cost studies are of value in price-setting, tariff-making, and other legislative and administrative measures.

Object of the present work

The aim in this study is to throw some light on the cost of producing rice by determining the individual farm costs as found in the most important rice region of the Islands. For a cost-inquiry study to fulfill all the uses enumerated elsewhere requires a personnel and outlay of money and time extensive enough to study comprehensively all the producing regions, and to take enough records to make the result a "reasonable index of existing conditions". Such a survey was beyond accomplishment by the writer under present conditions. However, the value of the survey of a limited area remains the same for the districts affected, especially when they are representative ones, and, in addition, they may serve as an index of conditions in other parts of the Islands.

That there is no such a thing as definite and specific cost figure has already been demonstrated. Costs differ widely on different farms, and even on the same farm yearly variations have been noted. The study here presented aims to show, so far as the survey covers, this wide range of cost. Material and labor requirements are also given.

¹ Experiment Station contribution No. 456. Received for publication June 20, 1927.

SCOPE AND METHOD OF STUDY

Time and place of survey

This study was carried out in three towns located in different parts of Pangasinan; namely, San Carlos, Mangaldan, and Balungao; and in Peñaranda and San José in Nueva Ecija. From these five towns data from 234 farms were obtained. These two provinces are the two premier rice producing provinces of the Philippines. The Bureau of Commerce and Industry (1926) shows that for the year ending June 30, 1924, they produced 12,779,000 cavans of palay which comprised 31 per cent of the total rice raised in the Islands. And of the 1,904,125 sacks of clean rice (equivalent to 3,910,254 cavans of palay) shipped to Manila over the Manila Railway from Central Luzon in 1925, they contributed about 73 per cent.

The investigation was carried out during vacation days of the writer in the summer of 1927, hence the data collected refer to the rice crop planted in 1926, but the rest of the farm operations, especially threshing, extends to the early months of 1927.

Method of collecting the data

The method used in collecting the data was the so-called "survey" method which consists of making personal visits to the farmers in the districts studied. Farmers keep no records so figures were from their estimates. Their estimates, however, may be given full face value as they have been doing the same thing for a number of years, and the simplicity of operations on the farm makes it possible for the figures to be held perfectly well in memory. To facilitate the taking and recording of information desired from the farmers, the writer took with him copies of prepared questions. Several landlords were also questioned as to land values and prices of product after harvest.

Elements of cost and method of computation

The different elements of cost may be given as follows: land cost, building cost, farm implement cost, cost of man (farmer's and outside) and animal labor, cost of seeds, and miscellaneous costs.

Land cost. The use-cost of land, or land rent, was made up of interest on sale value of land, and taxes. The rate of interest was ten per cent. Ten per cent is a conservative charge in these rice growing districts as elsewhere in Philippine rural regions. The same rate was used whenever interest was to be charged.

Labor cost. Man labor on the farm was supplied in two forms. One was by the farmer himself, as in seed bed and land preparation; another was by outside labor which was paid either on daily basis, or on the extent of the work finished, or on share. Co-operative labor, since it was repaid by the farmer with labor, was considered borne by him. The cost of the farmer's labor was calculated by using the actual daily rate at which such

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¹ Experiment Station contribution No. 456. Received for publication June 20, 1927.

The places surveyed do not have irrigation systems except in San José where several farms surveyed can be irrigated.

The survey dealt with the transplanting method, the general method of growing rice in these places. Numerous similarities and differences were noted in farm practice. In Pangasinan, rice farmers use bearded varieties and in Nueva Ecija, the non-bearded. In Pangasinan the bearded varieties used are Castaño, Binalolaqui, and Sinampurin in San Carlos; Contenido, Pinili, and Nalmuan in Mangaldan; and in Balungao, the popular varieties are Pinirencesa, Itang, and Piñas. Seeding is done during the months of May and June, planting principally in July and August, and harvesting generally in the months of November and December. The systems of seeding usually followed are the *capitan*, or harrowed in, and the *bakal*, or dropped in. Broadcast seeding is also done. The seed bed is plowed and harrowed from three to five times before seeding.

The field for transplanting is usually prepared during the months of June and July. It takes from one to two plowings and one to three harrowings to make the field ready for transplanting. Man labor alone is rated at from fifty centavos to one peso a day. At the age of about a month, depending upon the variety used, seedlings are pulled up for transplanting. Women usually do this work while men do the transplanting. Women pullers are paid about fifty centavos a day or by contract, from thirty to sixty centavos a hundred bundles of pulled-up seedlings. Men transplanters are paid from fifty to seventy centavos a day, often with food. Harvesting is done during the months of November, December, and as late as January. Harvesting is done principally on shares; one-fifth in San Carlos and Mangaldan, and from one-sixth to one-ninth in Balungao. Co-operative harvesting is also as common as on shares in Balungao. The heads of palay are cut off with an *atab*, *gamlang*, or *rakem*, which is a sickle or knife attached to a piece of wood for a handle. The harvested heads are tied in small bundles which are then tied into larger bundles called *capongo*, *manajo*, or *catanay*. After drying, these bundles are stored in *camaligs*, or storehouses which are built near the dwellings of many farmers. The bundle is the small unit of production and unthreshed rice is sold in this form.

In Nueva Ecija

In Nueva Ecija, non-bearded varieties are generally used except in places along the border of Pangasinan. In San José for example, bearded varieties are used to a limited extent; the most widely used varieties are the Saigon, Magkompol, and Inachupal. The most popular varieties in Peñaranda are the Macan-bocaué, Macan-aga, and Macan-putat. Seeding is done from the latter part of May up to June; planting, generally in the months of July and August; and harvesting, principally in November and December. The system of seeding in Peñaranda is the broadcast, or *palusad* while in San José, in addition, the *bakal* is used.

Fields are usually given one plowing and two to three harrowings. The harrows used are usually made of iron, but few iron plows are used. Man labor alone is generally rated at one peso a day. The general practice in Nueva Ecija is that seedlings are pulled up by men and the transplanting is done by women, a reversal of the practice in Pangasinan. However, in some places, as in San José, men also transplant to a limited extent. Pullers are paid from fifty centavos to sometimes as high as one peso a day; a planter from eighty centavos to one peso a day, or by contract, as in Peñaranda, from ten to twelve pesos a cavan of seed planted. In San José, women transplanters are paid fifty and sixty centavos a day and men one peso. The harvesting implement is usually the *linkao* in Peñaranda, while in San José the *palot* or *pangapas* is more generally used. Harvesting is either by co-operative system or by contract or daily wages of from fifty and sixty even up to eighty centavos a day. After harvest the bundles are allowed to dry for a few days and then are shocked and stacked. After several weeks in the stack the palay is threshed either by tractor-drawn thresher or by men and animals on shares ranging from six to ten per cent. The unit of production is the cavan. No storehouse, as in Pangasinan, is used; instead, farmers have buildings for shelter while working in the field.

Farm investment

In order to give an idea of the nature of rice farming with respect to investment, equipment, size and value of farms, table 1 was prepared.

A study of table 1 will show that the average farm area of the districts surveyed is less than two hectares, the average for all being 1.69 hectares; the average value from ₱263.76, as found in San Carlos (lowest), to ₱561.37 in San José (highest), or a general average of ₱449.51. Thus in value of land investment the average farm is less than a thousand pesos, the average for all farms being ₱764.92. In implements, each farm has slightly more than one plow and one harrow, the average per farm for all towns being 1.05. Several farms carry more than one work animal, the average figure being 1.23. The average price of animals ranges from less than ₱100 to about ₱130 or an average for all farms of ₱109.05, making an investment in animals per farm of ₱132.60. Only slightly more than one-half of the farms (or 0.55 in exact figures) have buildings as part of the farm investment, at an average cost of ₱16.74. Buildings on farms in Pangasinan are valued much higher than this average but the average is reduced because of low cost of farm buildings in Nueva Ecija where the average cost is but six pesos. The total investment per farm ranges from an average of ₱511.14, as found in San Carlos, to ₱1,214.99 in San José. This marked contrast is due to the marked difference in price of land. The average total investment per farm of all farms surveyed is ₱923.37. Of this amount, 82.84 per cent is in land, 14.36 per cent in animals, and the rest in equipment (1.70 per cent) and buildings (1.10 per cent).

COST OF PRODUCING RICE

Summary of costs

The cost figure has been assembled under five headings; namely, cost of man labor, animal labor, seed, and threshing, cost of the use of land, and other costs. The last named item includes use of buildings, use of equipment, and interest on operating expenses, and on some farms in San José the water charges. Dividing the total cost in each town by the number of hectares gives the cost per hectare. The cost of each unit of product was obtained by dividing the total of all costs by the total production. In table 2 are summarized the different items of cost per unit of product and per hectare of land as found in Pangasinan and Nueva Ecija. The unit of production, it will be observed, is not the same in the two provinces. The *capongo*, a bundle of rice panicles, is used in Pangasinan, while in Nueva Ecija the cavan is used. Inasmuch as the *capongo* is quite variable in size and more so in weight and the amount of clean rice that can be obtained from it, no attempt was made to make a comparison of production and cost between the two regions.

Table 2 shows the average cost a hectare of producing rice in Pangasinan and in Nueva Ecija. In Pangasinan the cost per hectare is from ₱98.50, the average in San Carlos, to ₱125.44, the average for Mangaldan; with a general average for the region of ₱110.56. The production to the hectare ranges from 103.08 *capongos* (for Mangaldan) to 140.09 *capongos*, the average for Balungao. This gives an average cost per *capongo* of ₱0.77 (Balungao) to ₱1.22, for Mangaldan, or an average for the entire region of ₱0.94. The cost of land and labor cost are the two important items in this cost, land alone constituting 40.86 per cent, and labor cost, 51.75 per cent (41.31 for man and 10.44 for animal). Seed constitutes 2.33 per cent and other costs, 5.06 per cent.

In Nueva Ecija, where the cost per hectare is greater than in Pangasinan because of higher land and labor cost, it may be seen that the average cost of producing rice per hectare is from ₱128.14 (in Peñaranda) to ₱152.55 (in San José) or an average of ₱140.35 for the entire region. The average yield is from 36.74 cavans for Peñaranda to 58.27 cavans for San José, or an average of 47.50 cavans. A great difference in yield in addition to other factors resulted in a great variation in cost per unit of product, this being ₱3.49 in Peñaranda and ₱2.62 a cavan in San José, or an average of ₱3.05. It may be stated at this point that San José is one of the highest yielding towns in Nueva Ecija, while Peñaranda is in the list of towns with very low yield. Of the average cost, 38.39 per cent is for land use, 38.60 for man labor, 8.66 for animal labor, 7.71 for cost of threshing, 1.77 for seed, and 4.87 per cent for other costs.

Variation in cost per hectare and per unit of product

As 40.86 per cent of the cost is due to cost of use of land, variation in cost per hectare is caused principally by the cost of use of land (see "Pangasinan" tables 1 and 2). Examination of tables will show that there is little variation in the amount of labor and labor rates. This is illustrated in Nueva Ecija where the labor cost is almost the same (table 3) but the total cost per hectare differs widely (table 2).

Variation in cost per unit of product is influenced by the cost per hectare and yield. The amount of yield, which is highly variable, is a factor greatly affecting the cost per unit of product. In Pangasinan (table 2) San Carlos showed a higher cost per *capongo* than Balungao although the latter had higher cost per hectare, but it had higher production. Of course, as with Mangaldan, a very high cost and only slight increase in yield may produce an unfavorable result. Data on Nueva Ecija (table 2) clearly show the effect of yield on cost per unit of product. A much higher cost per hectare in San José produced a low cost per cavan because of high yield. This relation should be taken into account by farmers and farm managers in attempting to get better farm incomes.

Labor cost

It may be seen that labor cost (man and animal) constitutes about half of the costs. Table 3 was prepared to show what part of this cost is man labor, what part is animal labor, and which operations on the farm consume the greatest amount of labor.

An examination of table 3 shows that the labor cost in all places surveyed in Pangasinan is ₱57.20 a hectare on the average. Of this amount, 79.84 per cent was the cost of man labor and only 20.16 per cent was animal labor. This means that each *capongo* which cost an average of ₱0.94 required ₱0.49 of man and animal labor. The operations were divided into the following headings: seed bed, land preparation, pulling up seedlings, transplanting, harvesting, and shocking and stacking. Of the labor cost, 35.80 per cent was for harvesting, 31.66 per cent for land preparation, 14.72 per cent for transplanting, and 7.26 per cent for seed bed.

In the two places in Nueva Ecija (table 3) the labor cost per hectare was nearly the same, the average being ₱66.33, or ₱1.47 per cavan of product. Of this cost, 81.68 per cent was man labor, and 18.32 per cent, animal labor.

Of the different field operations, land preparation used 36.77 per cent, transplanting, 20.23 per cent, and harvesting, 18.72 per cent. It will be observed that harvesting is the largest individual cost in Pangasinan, while in Nueva Ecija it is the second largest, because the method of harvesting by the *atab* in Pangasinan consumes much time.

Range in cost per unit of product

To show the range in cost per unit of product the two charts (charts 1 and 2) were prepared. The first chart is for farms in Pangasinan, and the second for Nueva Ecija, where a comparison of a highly productive and non-productive district is shown.

The minimum cost per *capongo* in Pangasinan is ₱0.42 as obtained from two farms and the highest is ₱2.05 (obtained from three farms). The average cost for all the farms surveyed is ₱0.94. From chart 1 it may be seen that 52 per cent of the growers in Pangasinan produced rice at a cost of ₱1.00 or less. Only six farms, or about 4.5 per cent, produced at a cost above ₱1.80 per *capongo*. Seventy-six per cent of all the farms produced rice at a cost of ₱1.50 or less a *capongo*.

In Peñaranda, Nueva Ecija, the average cost a cavan was ₱3.49, the lowest cost figure being ₱2.60 and the highest, ₱7.59. Only 24 per cent

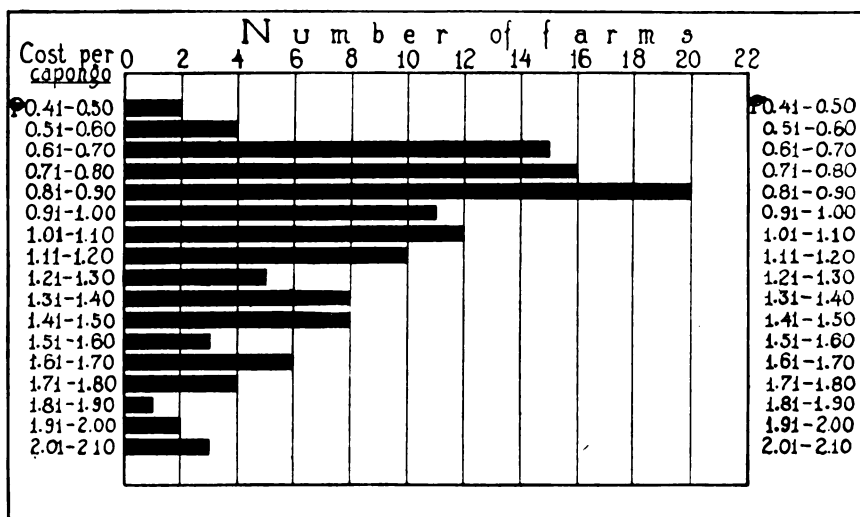


Chart 1.—Showing the range in cost per *capongo* of rice in Pangasinan, 1926-1927.

of the farms produced at a cost of ₱3.00 or less per cavan, and on 70 per cent the cost was ₱3.90 or below. Nine per cent produced at a cost above ₱5.00 a cavan. In San José, the average cost was ₱2.62 a cavan, the lowest being ₱2.05 and the highest, ₱4.71. Seventy-four per cent of the farms produced at the cost of ₱2.80 or less, on only four per cent was the cost ₱4.00 and above.

Return and margin above cost

Rice in San Carlos brought the farmers around 70 to 80 centavos a *capongo* during January and one peso in March. The starting point in other places surveyed in Pangasinan was around 80 centavos and one peso, staying at one-peso mark till the end of March. Previous prices reached as high as two pesos during September and October.

At 80 centavos a *capongo* (January price), only about 29 per cent of the farmers would have received their cost of production, with the majority receiving a profit of about 10 centavos. At one peso (March price) only about 52 per cent would have received amounts equal to their cost of production, with the majority receiving profit from 10 to 30 centavos a *capongo*. If the price of the 1926-27 crop ever reaches the two-peso point, then only about two per cent will fail to receive sufficient returns to compensate them for their cost of production.

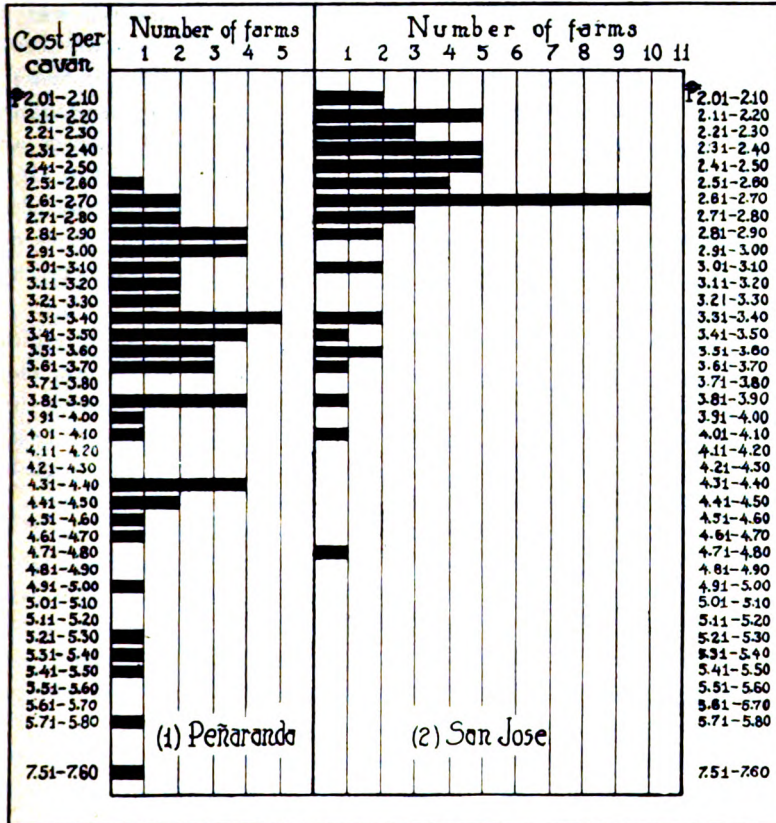


Chart 2.—Showing the range in cost per cavan of rice in (1) Peñaranda, and (2) San José, Nueva Ecija, 1926-1927.

The rice farmers in Nueva Ecija got around P3 a cavan as minimum price for their product, the price depending upon the distance of the farm from Cabanatuan. In Peñaranda the minimum obtained was P3.00, and in San José, P2.80. The 1927 price at Cabanatuan started around P3.30 to P3.50, depending upon the quality of the product. There was very little fluctuation in price for the first few months as the average for the period from January till end of May was from P3.30 to P3.50 a cavan.

At ₱2.80 a cavan, 74 per cent of the San José farmers would have received their cost of production, many with a margin above cost of from ten to thirty centavos. At ₱3.30, the price at end of May, only 18 per cent of the farms would have received less than the cost of production. In Peñaranda, at ₱3.00 but 24 per cent would have received cost of production. At ₱3.30, 35 per cent would have sold at cost.

Experience of farmers concerning price shows that during the months of August and September prices rise to ₱4.00 and even higher. The average price for July, August, and September, 1926, at Cabanatuan was from ₱4.42 to ₱4.53, depending upon quality². As 1926-27 rice production is greater than that of 1925-26, it is not expected that the price will reach the high level of the previous year. A comparison of prices from January to May, 1926, and of 1927 for the same period shows a difference of about seventy centavos per cavan. Mr. Hill (1927) estimates that the extreme rice peak for palay this year will not go over ₱3.75. At this price, 34 per cent of farmers in Peñaranda will not receive amounts sufficient to cover their cost of production, many of them losing one peso or more per cavan. In San José, but six per cent will have sold below cost.

This scale of prices shows what the farmers would get at different times of the year and the proportion of farmers that could not receive even cost at different prices. However, it is common knowledge that a great proportion of the rice crop raised in these regions is sold during the first months of the year,—from January to May. It may seem foolish for these farmers to sell their rice when the price is low and to buy it back later at nearly twice the price, but circumstances force them to do so. They have to meet obligations with money lenders who loan money payable after threshing of the crop,—a most unfavorable time for the farmers. In many cases, however, these farmers are to blame. They seem to take for granted that anything left over is a gain which they may use for present luxuries and they feel themselves in duty bound to indulge in a little pleasure and laziness, instead of saving for future times of stress.

The rice farmers sold a major part of their product at about ₱1.00 a *capongo* (summer price) in Pangasinan, and ₱3.30 a cavan in Nueva Ecija. Which means that of this major portion of the crop only 52 per cent is sold in Pangasinan at least at cost, a large part receiving a profit of from ten to thirty centavos a *capongo*. Forty-eight per cent of the crop sold at this period received from ten to fifty centavos less than the cost and as much as ₱1.00 in certain cases. In Peñaranda, Nueva Ecija, but 35 per cent of this part of the crop received at least cost, many sold with profit of from ten to forty centavos a cavan. The other 65 per cent received from ten centavos to one peso or more less than the cost of production. In San José, a fertile district, but 18 per cent of the part sold at this period

² Weekly market report of the Bureau of Commerce and Industry.

received less than cost, principally from ten to fifty centavos a cavan. A great many of the other 82 per cent, however, received profits of from forty to one peso a cavan.

BASIC REQUIREMENT PER HECTARE

A consideration of the basic factors of production—material and labor requirement—is essential, inasmuch as these factors do not vary greatly from year to year. Values may change from year to year, and to present cost on a money basis alone is inadequate since the result can not be compared with later studies when values have already changed. A knowledge of the basic requirement will enable one to get a close approximation of the total cost per hectare at any given time after applying cost of material and labor rates. Consequently, a close estimate of cost per unit of product could be obtained.

In table 4, the seed required and the number of days of man and animal labor needed per hectare in each of the different farm operations and percentage of each are given. Farm operations were divided into: seed bed, plowing, harrowing, pulling up seedlings, transplanting, harvesting, and shocking and stacking.

Table 4 shows that in Pangasinan an average of 2.54 *capongos* of seed is required per hectare. An average of 56.91 days of man labor and 14.96 days of animal labor is needed to produce a hectare of rice, or about 0.48 days of man labor and 0.13 days of animal labor, per *capongo* of product. Of the amount of man labor required, the greater part is spent in harvesting (47.32 per cent), transplanting (16.92 per cent), and land preparation (19.75 per cent). Of the animal labor, the greater part is spent in plowing (52.68 per cent), harrowing (22.46 per cent), and seed bed preparation (16.04 per cent).

In table 4 are also shown the basic requirements for a hectare of rice in Nueva Ecija. An average of 20.05 gantas of palay is needed per hectare, and 51.32 days of man labor and 17.07 days of animal labor, or 1.08 and 0.36 days of man and animal labor, respectively, for each cavan of product. Of the days of man labor, harvesting consumed 27.08 per cent; transplanting, 23.62 per cent; and land preparation, 23.86 per cent. Of the animal labor days, plowing consumed 42.18 per cent; harrowing, 29.52 per cent; shocking and stacking, 18.22 per cent; and seed bed, 10.08 per cent.

A comparison of the two provinces will show that the Pangasinan farmer used nearly six days more of man labor but two days less of animal labor than the farmer in Nueva Ecija. This is because harvesting in Pangasinan with the use of the *atab* is a slow process. The percentage of man labor in different operations will show the striking difference. The Nueva Ecija farmer used two days more of animal labor partly because of stacking.

SUMMARY OF CONCLUSIONS

Within the limit of the survey, the following conclusions may be drawn.

1. The average rice farm in Pangasinan and Nueva Ecija has an average area of 1.69 hectares, valued at an average of ₱449.51 a hectare. The total of average investment is ₱923.37, 82.84 per cent of which is in land, 14.36 per cent in animals, and the remainder in buildings (1.10 per cent) and equipment (1.70 per cent).

2. The 1926-27 rice crop cost the Pangasinan farmer an average of ₱0.94 a *capongo*, 51.75 per cent of which was the cost of man and animal labor, and 40.86 per cent, the cost of use of land.

3. It cost the Nueva Ecija farmer an average of ₱3.05 a cavan, 47.26 per cent of which was the cost of man and animal labor, and 38.39 per cent the cost of use of land.

4. Of man and animal labor cost (₱57.20 a hectare) in Pangasinan (which was 51.75 per cent of all costs), an average of 79.84 per cent was man labor and 20.16 per cent, animal labor. Harvesting required a greater cost (35.80 per cent) than land preparation (31.66 per cent), or transplanting (14.72 per cent).

5. In Nueva Ecija, of the ₱66.33 labor cost per hectare (which was 47.26 per cent of total cost) 81.68 per cent was the cost of man labor and 18.32 per cent, animal labor. Land preparation consumed the greatest individual operation (36.77 per cent); harvesting, 18.72 per cent; transplanting, 20.23 per cent; and shocking and stacking, 14.16 per cent.

6. The cost per *capongo* in Pangasinan varied from ₱0.42 to ₱2.05. Fifty-two per cent of the growers in Pangasinan produced rice at a cost of ₱1.00 or less; 76 per cent at ₱1.50 or less, and only 4.5 per cent at a cost above ₱1.80.

7. The cost of a cavan of rice in Nueva Ecija ranged from ₱2.05 (found in San José) to ₱7.59 (found in Peñaranda). In Peñaranda only 24 per cent of the farms produced at a cost of ₱3.00 or below, 70 per cent at ₱3.90 or less, 28 per cent at above ₱4.00, and 9 per cent at above ₱5.00. In San José, 74 per cent produced at ₱2.80 or less, and only 4 per cent at above ₱4.00.

8. At the price of ₱0.80 a *capongo* (January price), only about 29 per cent of farmers would have received their cost of production, the majority receiving a profit of ten centavos a *capongo*. At ₱1.00 (March price) 52 per cent would have received their cost of production. At ₱2.00 only 2 per cent would have received less than cost of production.

9. At the price of ₱2.80 a cavan, 74 per cent of the San José farmers would have received cost of production, the majority of them receiving a profit of from ten to thirty centavos. At ₱3.00 but 24 per cent could have received cost of production in Peñaranda, this percentage being increased to 35 per cent at ₱3.30 (March price). In San José, at this price, the per-

centage would be increased to 82 per cent. At ₱3.75, only six per cent would not have received cost of production in San José, while in Peñaranda the percentage would be 34 per cent.

10. As a major portion of the rice produced was sold during summer, then for this part of the production in 1927 about ₱1.00 a *capongo* was received in Pangasinan, and ₱3.30 a cavan in Nueva Ecija. At these prices only 52 per cent of the portion sold in Pangasinan and in Nueva Ecija, 35 per cent in Peñaranda and 82 per cent in San José, was sold at least at cost; many of the producers, however, received a profit of from ten centavos up. On the other hand as much as 48 per cent of this part of the crop in Pangasinan was sold at fifty centavos or more below the cost of production. In Peñaranda, Nueva Ecija, 65 per cent was sold at a loss of from ₱0.10 to ₱1.00 or more a cavan, while in San José only 18 per cent was sold at less than cost.

11. To grow a hectare of rice in Pangasinan requires an average of 2.54 *capongos* of seed, and 56.91 days of man labor and 14.96 days of animal labor. Man labor is mostly spent in harvesting (47.32 per cent), land preparation (19.75 per cent), and transplanting (16.92 per cent). Of days of animal labor, plowing consumed 52.68 per cent; harrowing, 22.46 per cent; and seed bed, 16.04 per cent.

12. A hectare of land in Nueva Ecija requires 20.05 *gantas* of palay seed, 51.32 days of man labor, and 17.07 days of animal labor. Man labor is principally required in harvesting (27.08 per cent), land preparation (23.86 per cent), and transplanting (23.62 per cent). Of days of animal labor, an average of 42.18 per cent is spent in plowing the field, 29.52 per cent in harrowing, 18.22 per cent in shocking and stacking, and 10.08 per cent in seed bed preparation.

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TABLE 1

Showing nature and value of farm investment on rice farms in Pangasinan and Nueva Ecija, 1926-1927

	PANGASINAN			NUEVA ECIJA		AVERAGE	PERCENT- AGE OF INVEST- MENT
	San Carlos	Mangaldan	Balungao	Peñaranda	San José		
Number of farms.....	34	46	50	54	50		
Total area (hectares)...	50.33	62.60	90.53	104.71	92.72		
Total cost (pesos).....	13,275.00	32,924.98	42,900.00	44,246.99	52,050.00		
Av. cost per hectare....	263.76	525.96	473.88	422.57	561.37	449.51	
Av. area per farm.....	1.48	1.37	1.81	1.94	1.85	1.69	
Av. cost per farm.....	390.44	715.76	858.00	819.39	1,041.00	764.92	82.84
Number of animals.....	37	53	81	60	59		
Total cost (pesos).....	3,455.00	5,490.00	7,370.00	7,795.00	7,514.00		
Av. cost per animal....	93.38	103.58	90.99	129.92	127.36	109.05	
Av. animal per farm...	1.09	1.15	1.62	1.11	1.18	1.23	
Av. cost per farm.....	101.62	119.35	147.40	144.35	150.28	132.60	14.36
Number of plows.....	34	46	62	55	50		
Total cost (pesos).....	221.50	291.00	587.50	448.00	518.80		
Av. cost per plow.....	6.51	6.33	9.48	8.15	10.38	8.17	
Av. plow per farm.....	1.00	1.00	1.24	1.02	1.00	1.05	
Av. cost per farm.....	6.51	6.33	11.75	8.30	10.38	8.65	0.94
Number of harrows....	34	46	65	54	47		
Total cost (pesos).....	43.50	58.50	58.50	419.50	384.50		
Av. cost per harrow....	1.28	1.27	0.90	7.76	8.18	3.88	
Av. harrow per farm...	1.00	1.00	1.30	1.00	0.94	1.05	
Av. cost per farm.....	1.28	1.27	1.17	7.76	7.69	3.83	0.41
Sled and other equip- ment cost.....	70.70	134.85	127.70	249.20	189.10		
Av. cost per farm.....	2.08	2.93	2.55	4.61	3.78	3.19	0.35
Number of buildings...	15	33	36	23	22		
Total cost (pesos).....	313.00	744.25	1,012.00	183.00	93.00		
Av. cost per building...	20.87	22.55	28.11	7.96	4.23	16.74	
Av. building per farm...	0.44	0.72	0.72	0.43	0.44	0.55	
Av. cost per farm.....	9.21	16.18	20.24	3.39	1.86	10.18	1.10
Av. investment per farm (pesos).....	511.14	861.82	1,041.11	987.80	1,214.99	923.37	100.00

TABLE 2
Summary of cost of producing rice in Pangasinan and Nueva Ecija, 1926-1927

	PANGASINAN			AV. PER HECTARE		NUEVA ECIA		AV. PER HECTARE	
	San Carlos	Mangaldan	Balungao	Cost	Percentage of cost	Pedarranda	San José	Cost	Percentage of cost
Number of farms.....	34	46	50			54	50		
Total area (hectares).....	50.33	62.60	90.53			104.71	92.75		
Total production (<i>capongo</i> or <i>cavan</i>) ^a	5,820.00	6,453.00	12,682.00			3,847.00	5,405.00		
Av. yield per hectare.....	115.64	103.08	140.09	119.60		36.74	58.27	47.50	
Man labor cost: ^b	P2,608.09	P2,889.45	P3,533.85	P45.67	41.31	P5,773.46	P4,936.45	P54.18	38.60
Seed bed.....	73.55	202.20	176.05	2.21		248.46	183.20	2.18	
Land preparation.....	412.05	833.40	644.15	9.54		1,566.30	1,564.80	15.92	
Pulling up seedlings.....	177.60	202.40	154.60	2.82		438.30	234.65	3.36	
Transplanting.....	591.00	428.40	603.50	8.42		1,508.80	1,152.30	13.42	
Harvesting.....	1,241.50	1,085.30	1,760.10	20.48		1,437.90	1,031.50	12.43	
Shocking and stacking.....	112.39	137.73	195.45	2.20		573.70	770.00	6.87	
Animal labor cost.....	526.37	782.52	1,053.50	11.54	10.44	1,153.14	1,232.44	12.15	8.66
Use of land.....	1,448.66	3,581.91	4,483.50	45.18	40.86	4,808.99	5,735.83	53.88	38.39
Threshing cost.....						923.28	1,189.10	10.82	7.71
Seed cost.....	118.25	207.00	190.25	2.58	2.33	263.82	227.25	2.49	1.77
Other costs: ^b	256.12	391.83	490.72	5.59	5.06	494.67	828.40	6.83	4.87
Use of implements.....	145.21	198.60	247.96	2.93	2.65	297.33	314.16	3.12	2.21
Use of buildings.....	52.67	135.29	171.96	1.70	1.54	55.94	41.39	0.49	0.35
Miscellaneous.....	58.24	57.94	70.80	0.96	0.87	141.40	472.85	3.22	2.31
Total cost.....	4,957.49	7,852.71	9,751.82	110.56	100.00	13,417.36	14,149.47	140.35	100.00
Av. cost per hectare.....	98.50	125.44	107.72	110.56		128.14	152.55	140.35	
Av. cost per <i>capongo</i> or <i>cavan</i> ^a	0.85	1.22	0.77	0.94		3.49	2.62	3.055	

^a *Capongo* is the unit of measure used in Pangasinan.

^b *Cavan* is the unit used in Nueva Ecija.

This cost is total of individual costs listed under it.

TABLE 3
Summary of labor costs involved in different farm operations in Pangasinan and Nueva Ecija, 1926-1927

	PANGASINAN			AV. PER HECTARE		NUEVA ECIA		AV. PER HECTARE	
	San Carlos	Mangaldan	Balungao	Cost	Percentage of cost	Peñaranda	San José	Cost	Percentage of cost
	pesos	pesos	pesos	pesos		pesos	pesos	pesos	
Seed bed: ^b	141.12	342.96	378.03	4.15	7.26	378.35	288.12	3.35	5.05
Man labor.....	73.55	202.20	176.05	2.21	3.86	248.46	183.20	2.17	3.27
Animal labor.....	67.57	140.76	201.98	1.94	3.40	129.89	104.92	1.18	1.78
Land preparation: ^b	816.78	1,424.45	1,388.90	18.11	34.66	2,366.87	2,427.14	24.39	36.77
Man labor.....	412.05	833.40	644.15	9.54	16.68	1,566.30	1,564.80	15.92	24.00
Animal labor.....	404.73	591.05	744.75	8.57	14.98	800.57	862.34	8.47	12.77
Pulling up seedlings:									
Man labor.....	177.60	202.40	154.60	2.82	4.93	438.30	234.65	3.36	5.07
Transplanting:									
Man labor.....	591.00	428.40	603.50	8.42	14.72	1,508.80	1,152.30	13.42	20.23
Harvesting:									
Man labor.....	1,241.50	1,085.30	1,760.10	20.48	35.80	1,437.90	1,031.50	12.42	18.72
Shocking and stacking: ^b	166.46	188.46	302.22	3.22	5.63	796.38	1,035.18	9.39	14.16
Man labor.....	112.39	137.75	195.45	2.20	3.85	573.70	770.00	6.89	10.39
Animal labor.....	54.07	50.71	106.77	1.02	1.78	222.68	265.18	2.50	3.77
Total man labor.....	2,608.09	2,889.45	3,533.85	45.67	79.84	5,773.46	4,936.45	54.18	81.68
Total animal labor.....	526.37	782.52	1,053.50	11.53	20.16	1,153.14	1,232.44	12.15	18.32
Total labor.....	3,134.46	3,671.97	4,587.35	57.20	100.00	6,926.60	6,168.89	66.33	100.00
Man labor per ha.....	51.82	46.16	39.03	45.67	79.84	55.14	53.22	54.18	81.68
Animal labor per ha.....	10.46	12.50	11.64	11.53	20.16	11.01	13.29	12.15	18.32
Labor cost per ha.....	62.28	58.66	50.67	57.20	100.00	66.15	66.51	66.33	100.00
Production per ha. (capongos or cavan) ^a	115.64	103.08	140.09	119.60	—	36.74	58.27	47.50	—
Labor cost per capongo or cavan (pesos).....	0.54	0.57	0.36	0.49	—	1.80	1.14	1.47	—

^a Capongo is the unit of measure used in Pangasinan.

Cavan is the unit used in Nueva Ecija.

^b Cost of operation includes both man and animal labor.

TABLE 4

Labor and material requirement of a hectare of rice in Pangasinan and Nueva Ecija, 1926-1927

	PANGASINAN			AVERAGE	AVERAGE MAN LABOR REQUIRED		AVERAGE ANIMAL LABOR REQUIRED		NUEVA ECIA		AVERAGE		AVERAGE MAN LABOR REQUIRED		AVERAGE ANIMAL LABOR REQUIRED	
	San Carlos	Mangal- dan	Balun- gao		days	per cent	days	per cent	Peña- randa	San José	days	per cent	days	per cent		
Number of farms.....	34	46	50	119.60	.....	.....	.....	.....	54	50	.....	.....	.....	.....	.....	.....
Yield per ha. (<i>capongo</i> or cavan) ^a	115.64	103.08	140.09	2.54	.....	.....	.....	.....	36.74	58.27	47.50	.....	.....	.....	.....	.....
Seed needed (<i>capongo</i> or gantas) ^a	2.20	3.31	2.10	2.40	.....	.....	.....	.....	20.82	19.27	20.05	.....	.....	.....	.....	.....
Seed bed preparation:																
Man labor (days).....	1.34	3.34	2.51	2.40	4.22	.....	.....	.....	1.87	1.57	1.72	3.35	.....	.....	.....	.....
Animal labor (days).....	1.34	3.34	2.51	2.40	.....	2.40	16.04	.....	1.87	1.57	1.72	.....	.....	.....	1.72	10.08
Plowing field:																
Man labor (days).....	8.11	10.06	5.46	7.88	13.85	.....	.....	.....	6.65	7.76	7.20	14.03	7.20	.....	.....	.....
Animal labor (days).....	8.11	10.06	5.46	7.88	.....	7.88	52.68	.....	6.65	7.76	7.20	.....	.....	.....	7.20	42.18
Harrowing field:																
Man labor (days).....	2.30	3.99	3.79	3.36	5.90	.....	.....	.....	4.89	5.18	5.04	9.83	5.04	.....	.....	.....
Animal labor (days).....	2.30	3.99	3.79	3.36	.....	3.36	22.46	.....	4.89	5.18	5.04	.....	.....	.....	5.04	29.52
Pulling up seedlings:																
Man labor (days).....	3.89	5.55	3.24	4.23	7.43	.....	.....	.....	3.93	3.15	3.54	6.90	3.54	.....	.....	.....
Transplanting:																
Man labor (days).....	11.44	9.06	8.40	9.63	16.92	.....	.....	.....	10.34	13.89	12.12	23.62	12.12	.....	.....	.....
Harvesting:																
Man labor (days).....	15.51	32.12	33.16	26.93	47.32	.....	.....	.....	13.46	14.34	13.90	27.08	13.90	.....	.....	.....
Shocking and stacking:																
Man labor (days).....	2.83	2.00	2.61	2.48	4.36	.....	.....	.....	7.09	8.51	7.80	15.20	7.80	.....	.....	.....
Animal labor (days).....	1.39	1.25	1.33	1.32	.....	1.32	8.82	.....	3.21	3.01	3.11	.....	.....	.....	3.11	18.22
Total man labor (days).....	45.42	66.12	59.17	56.91	100.00	.....	.....	.....	48.23	54.40	51.32	100.00	51.32	.....	.....	.....
Total animal labor (days).....	13.14	18.64	13.09	14.96	.....	14.96	100.00	.....	16.62	17.52	17.07	.....	.....	.....	17.07	100.00
Labor per <i>capongo</i> or cavan ^a (days).....				0.48	.....	0.13	.....	.....	.....	.....	1.08	.....	1.08	.....	0.36	.....

^a *Capongo* is the unit of measure used in Pangasinan.

Cavan and ganta are units used in Nueva Ecija; 25 gantas equal one cavan.

SOME EXPERIMENTS ON FARM TANNING¹

ILDEFONSO A. PALISOC

INTRODUCTION

In many parts of the Islands hides and skins can be bought at low prices, and when tanned, may be sold at a considerable advance. It would seem that a knowledge of some of the practical methods of tanning might be of value to farmers, for they have little work to do on the farm some periods in the year and tanning would give them a profitable occupation for these idle times.

Review of previous work

In spite of the importance of tanning hides as an occupation in the Islands, there has been little published on the subject. In some other countries, however, there is considerable published material on tanning. But the writer has limited himself to Philippine literature in reviewing past work and such publications as were consulted in connection with the carrying out of this work.

Of the work carried out in the Philippines, Gana (1915) states that the Filipino method of tanning hides is primitive and very inefficient. He advocates the use of a combination of camanchili and mangrove barks as tanning materials to produce a good quality of leather at moderate expense. According to Gana (1916) these barks are the only materials used in the Filipino method of tanning.

Frey, Clarke, and Veitch (1922) claim that the use of salt-alum and salt-sulfuric acid are satisfactory to use for home tanning of fur skins. They further state that the salt-alum process is slightly better than salt-sulfuric acid formula. These authors state that the leather produced by the salt-oxalic acid or any other mineral acid method is not durable. They contend that the leather produced by sumac or other similar tanning materials is unquestionably the best quality as to serviceability or durability, and is better than that tanned with hemlock bark or with similar tanning materials.

Object of present work

The object of this work was to determine efficient and economical formulæ for tanning hides on the farm in the Philippines.

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Time and place

In connection with these studies, two lines of investigation were carried out. One consisted of a preliminary investigation made on the industry in San Carlos and Binmaley, Pangasinan, and in the Philippine Tannery, Malabon, Rizal. The other consisted of actual experiments performed at the College of Agriculture, University of the Philippines.

The work was conducted from April, 1923, to February, 1925.

MATERIALS

Hides and skins of various classes of animals were used; namely, four and one-half cattle hides, one carabao hide, seven goat skins and one dog skin. All excepting two goat skins and one dog skin were divided into halves to afford more material for the different methods of tanning tried.

For the removal of hair, air-slaked lime was used. In both native and foreign methods this was used. Vinegar containing four per cent of acetic acid was used to remove the lime that adhered to the tissues of the hide or skin after dehairing and washing, thus insuring the pliability and cleanness of the hides and skins. Tanning chemicals were employed with all foreign methods of tanning; these consisted of sulfuric acid, alum, oxalic acid, borax, common table salt and green soap. In performing the native method of tanning the bark of camanchile (*Pithecolobium dulce* Benthham) was used. The bark was in the green state.

For purposes of stretching and drying the hides and skins, two pieces of board were used. Each board was about two meters long and one-half meter wide. On these boards hides and skins were stretched and nailed before drying.

Before the hides and skins were salted for curing, the fatty and extraneous tissues were removed with a knife. A bolo was used in stripping the bark off camanchile and in cutting it up into small pieces.

A piece of flattened iron 30 cm. long, bent at both ends so a wooden handle 12 cm. in length could be fastened to it was used to remove the hair from the skins and hides. The edge of this tool was dulled so as to prevent the cutting of the hides and skins in the process of scraping.

To facilitate the extraction of juice, the tan bark was disintegrated by pounding it in a mortar.

In the processes of dehairing and tanning, the hides and skins were soaked in earthen jars, each large enough to hold one-half of a cattle hide.

METHODS

Fleshing and cleaning

There was some flesh and other extraneous tissues on practically all hides and skins used and they were dirty. To prevent the deterioration of the skins and to let the curing, dehairing, and tanning materials penetrate

the skins most effectively, this flesh and other tissues were removed with a fairly sharp knife, great care being exercised that the skins were not injured. All dirt adhering to both the hair and flesh sides of the hides was washed off with water. The water was drained off by hanging up the hides.

Salting and curing

Salting is an important phase in the preparation of hides before tanning. Hides that are not properly salted at the right time are likely to rot and become unfit for tanning, or if used will make poor leather.

In the process of salting, each piece of the hide or skin was spread on a wooden floor with the flesh side up and the salt was sprinkled liberally and evenly all over the surface. Then the hide was folded with the flesh side in, and rolled up, and placed in a box and left over-night. The next morning it was unrolled and if the salt had been absorbed the skin or hide was spread out and more salt was applied, after which it was folded and rolled as before. This process was repeated for three successive days.

Both skins and hides that were properly salted, turned firm and hard, and were free from a disagreeable odor. The salt did not affect the hair at all. After the three days salting, the skin or hide was spread on a framework and exposed until fairly dry. In this condition the skins were kept until the dehairing and tanning materials were prepared.

Dehairing

So the dehairing material could penetrate the skin or hide, it was washed thoroughly to remove the salt and other foreign matter that had accumulated in the process of salting and drying. It was then immersed in water for twenty-four hours to soften the tissues, before it was dipped in a lime solution with a strength of 2.5 kilograms of lime for every fifty liters of water. As soon as the hair started to loosen so it could be easily scraped off, the skin was spread vertically on a board and the hair scraped downward until it all was removed. The skin was then turned over and the flesh side scraped to remove the fatty and other extraneous tissues.

Tanning

The following methods of tanning were employed in conducting these experiments:

Native method. The bark of camanchile was used in this method. The tanning extract was prepared by soaking for two days twenty-eight kilograms of bark in thirty liters of water. This process extracted the tanning principle from the bark.

When the lime and hair had been scraped from each skin it was folded; the skins were piled one upon the other and the whole completely immersed in the tanning solution. To facilitate the penetration of tanning extract a quantity of shredded camanchile bark was spread between the

layers of skin. The skins were examined daily and rearranged to insure proper and equal penetration of the tanning solution into the different tissues.

Foreign methods: 1. "Tanning a deer skin."—C. O. ORMSBEE.

Dissolve alum in soft water at the rate of one pound (.45 kilogram) to four gallons (15.14 liters) of water. Soak the cleaned skin twenty-four hours, pulling and stretching frequently to avoid wrinkles which interfere with a uniform penetration. At the end of the twenty-four hours or a little later, wring the skin as dry as possible and spread on the floor with flesh side up. Sprinkle liberally with a mixture of equal parts alum and salt. Fold together, roll tightly and lay away for twenty-four hours. Then unroll, pull and stretch, the more the better. Sprinkle again with mixture, fold, roll and lay away. Repeat daily until skin will absorb no more. Ten days are generally required to tan.

2. "Tanning leather"—CALIFORNIA CULTIVATOR.

To each gallon (3.79 liters) of water, add one quart (0.95 liter) of salt and one-half ounce (14.17 grams) of sulfuric acid. Do not put in a metal container. Thin skins tan in this liquor in one day. Heavy skins take longer and can stay in quite long and not be injured. When removing skins wash in soapy water, wring dry and rub on the flesh side with a cake of soap. Fold in middle and hang lengthwise on outstretched line, hair side out, and leave to dry. When both surfaces are barely dry, the interior is fairly moist.

3. "Tanning skins with and without hair"—R. C. HODGSON.

Before tanning a skin, soak it well in a mixture made as follows: Take four gallons (15.14 liters) of cold soft water, one-half pint (458.05 cc.) soap, one-half ounce borax (14.17 grams), and one-half pint (458.05 cc.) salt; mix and immerse skins. If the hair or wool is to be left on, add three-fourths ounce of sulfuric acid. Soak from two to six hours. If the hair is to be removed, use a special dehairing formula.

Tanning liquor:—Eight quarts (7.6 liters) cold soft water, one-fourth pound (11.3 grams) pulverised oxalic acid, and one quart salt; dissolve well and immerse skins. Light skins require three to four hours, heavy skins forty-eight or more hours until tanned. This can be told by examining the thickest part.

DISCUSSION OF RESULTS

Time necessary for curing

The success in the production of a good quality of leather depends not only upon the method of tanning employed, but also upon the condition of the hide or skin and upon the way the work is done. Whalin, Frey, Veitch, and Hichman (1919) found that poorly cured hides become spoiled in the tanning liquor, this condition being detected by the presence of spoiled tissues. The writer observed that poorly cured hides may be detected after standing five days in lime solution by the forming of spots of decaying tissues. These decayed spots are soft and velvety in texture and have a disagreeable odor. According to the tanners in San Carlos and Binmaley, Pangasinan, if a hide or skin is not properly cured it is likely to rot after it has laid for three days in lime solution.

In the experiment reported in this paper one cattle hide was salted on each of the following dates: February 12 and 16, May 13, 1923, and January 5, 1924. These hides were kept in an empty kerosene box over-night, and by the next morning liquid material was found to be draining from them. The amount of this liquid became gradually less until the third day when the hides were just moist. At this time the texture of the skin was rather firmer than it was before the application of salt. No disagreeable odor developed during the time the skins were kept in the box, showing that no

fermentation or putrefaction had taken place. The hair was observed to adhere as firmly to the hide as it did when the skin was just removed from the body of the animal. Two days after the second application of common salt a slight degree of firmness and hardness of the skin was observed. As more salt was applied the harder the skin became until the fifth day.

According to Gana (1915) hides require from one to two weeks to cure. He advises that salted hides should be stored in a cool dark room where they could be protected from drafts. Whalin, Frey, and Hichman (1919) state that the application of salt should not be made until the seventh hour after the removal of the hides from the body of the animal; this time is necessary to allow the skin to cool. In places where the weather is cold a hide may be left unsalted over-night. These authorities further indicate that hides generally require from six to fourteen days to cure.

Time necessary for the removal of hair

Table 1 shows the average length of time required to remove the hair from the different hides or skins. The time required to remove the hair of cattle is twelve days; of carabao, eleven; and of goat, seven; all having been treated with the same concentration of lime solution. The difference

TABLE 1
*The time necessary for the removal of hair from
different hides*

KIND OF HIDE	NUMBER OF HIDES, OR SKINS	TIME NECESSARY FOR THE REMOVAL OF HAIR
		<i>days</i>
Cattle	4½	12
Carabao	1	11
Goat	6	7

in time just referred to appears to be due to the difference in thickness; the thicker the hide the longer the time. It was observed that in all the cattle and carabao hides the swelling of the epidermal tissues and of the hide as a whole took place on the third day, and the hair began to slip off on the fifth day. These changes in the thickness and texture of the hides and the degree of loosening of the hair from the hides became more marked as the period in the dehairing process advanced. In the case of goat skins the swelling of the epidermal cells and the change in the texture of the skins were detected on the second day. The hair began to slip off on the third day using the same kind and concentration of dehairing solution as with the other skins. Swelling of hides was very marked on the seventh day when the hair on all portions could be rubbed off easily with a slight touch of the finger. According to Rogers (1915) the swelling of the epidermal tissues is due to the lime soap formed from the union of the lime and fatty matter of the hides, causing the hair to loosen and finally to slip off. It was further observed that in all hides there was formed a cheese-like substance that was scraped off with the hair during the dehairing process. Frey,

Clarke, and Veitch (1922) state that the presence of cheesy matter is an indication that the hide is sufficiently limed. It is further pointed out by these authors that the removal of hair from the hide requires from six to ten days in summer, and 16 days in winter in a lime solution made by dissolving 4.53 kilograms of caustic lime in 19 liters of water.

Time necessary for tanning

Native method. Seven pieces of hides from the three classes of animals, carabao, cattle, and goat, were tanned. The pieces were first soaked in water for two days, carefully examining each piece morning, noon, and afternoon. The water was changed during the soaking. After 12 hours in the water the hide began to become soft and pliable. This quality continued during the remaining 36 hours of soaking before the skins were put in the tanning solution. Local tanners claim that the removal of lime from the tissues of the hide makes it soft and pliable.

During the tanning process, observation was made morning and afternoon. A small cut was made along the edges of the hides, particularly at the thickest portions, and observations were taken on these cuts. As may be seen in table 2, in the case of the goat skins, it was six days before the material appeared completely tanned. Within this period of time there occurred marked changes in the color of the cross sections of the hide, from light gray to the dull light brown of tanned leather. With cattle and carabao hides, the cross section of the cut edges did not show any change in color until the seventh day when a distinct dark line was in evidence. This line disappeared gradually and slowly, requiring 25 days with cattle hides, and 34 days with the carabao hide, from the time the hides were put to soak in tanning solution (see table 2). At the end of these periods the color

TABLE 2

Results obtained with the native method of tanning

HIDE NO.	WEIGHT OF RAW HIDE	WEIGHT OF TANNED HIDE	LOSS IN WEIGHT		DURATION OF			
					Soaking in water	Dehairing in lime solution	Deliming in water	Tanning in camanchili extract
Goat skin No. 1	grams 208.2	grams 150.0	grams 58.8	per cent 28.22	1 day	7 days 4 hours	2 days	6 days 23 hours
Goat skin No. 2	152.2	110.0	42.2	27.72	1 day	7 days 4 hours	2 days	5 days 23 hours
Goat skin No. 3	104.2	75.2	28.7	21.01	1 day	5 days 1 hour	2 days	5 days 23 hours
Goat skin No. 4	175.0	115.0	50.0	28.57	1 day	7 days	2 days	6 days
Goat skin No. 5 ^a	83.7	80.0	3.7	4.43	1 day	6 days	2 days	6 days
Carabao hide No. 1	8000.0	6900.0	1100.0	14.75	1 day	9 days	2 days	34 days
Cattle hide No. 1	300.0	205.0	95.0	31.67	1 day	9 days	2 days	25 days

^aGoat skin No. 5 was in dry form.

was dull light brown. According to Gana (1915) this color of leather is due to the fact that the camanchile extract contains but little coloring matter.

During the immersion of the hides in the tanning solution a disagreeable odor developed, which according to Gana (1915) is caused by the putrefaction of nitrogenous compounds contained in the hides.

Hides of different species of animals require varying lengths of time to tan because of the difference in thickness of the hides; the thicker the material the longer the time required for the tanning solution to penetrate through it.

Foreign methods. In carrying out the foreign methods of tanning, all hides, excepting those that were tanned with the hair on, were soaked in vinegar for one day before they were immersed in the tanning solution. The concentration of the vinegar solution was one-half liter of vinegar to every 76 liters of water (Veitch, etc., 1922). The hides soaked in this solution were examined at three-hour intervals during the day time, and it was noticed that after six hours the hides were soft and pliable. These changes increased until the hides were removed and put in the tanning solution. Frey, Clarke, and Veitch (1922) who conducted experiments of a similar nature state that the softness and pliability of the hides are the result of the removal of lime contained in the tissues.

Foreign Method No. 1. "Tanning a deer skin"—C. O. Ormsbee (Sandhouse, 1922):

Cattle hides and goat skins were tanned by this method. The hides were first soaked in alum solution at the rate of 500 grams of alum to every 15.2 liters of fresh water. The hides were immersed for 24 hours during which time regular inspection was made to insure proper and even penetration of the solution into the tissues.

After the hides had been soaked in the alum solution, they were removed and hung under shade to drain over-night. Then a tanning mixture of equal parts by weight of alum and common salt was dusted on the flesh side. The hides were rolled and laid aside until the mixture had been absorbed. Beginning the next day the mixture was applied, continuing daily for one week. Then, because the tissues were about saturated with the mixture, at longer intervals until the hides appeared completely tanned. As may be seen in table 3 a cattle hide weighing 5600 grams required 26

TABLE 3

Results obtained with salt-alum method of tanning (Foreign Method No. 1)

HIDE NO.	WEIGHT OF RAW HIDE	WEIGHT OF TANNED HIDE	LOSS IN WEIGHT		DURATION OF			
					Soaking in alum solution	Dehairing in lime solution	Deliming in vinegar solution	Tanning in salt-alum mixture
	grams	grams	grams	per cent	day	days	day	days
Cattle hide No. 1	5600.0	3050.0	2550	45.53	1	12	1	26
Goat skin No. 1	400.0	165.0	235.0	58.75	1	12	1	12

days to tan, while a goat skin required only 12 days. Sandhouse records that with a deer skin it required ten days to tan it, the skin being daily stretched and dusted with the tanning mixture. The goat skin is about as light weight as a deer skin and required 12 days to tan it, applying the mixture four times.

Foreign Method 'No. 2. "Tanning leather"—*California Cultivator* (Sandhouse, 1922):

In testing this method of tanning, one piece of carabao hide, three pieces of cattle hides and one piece of goat skin were used. The hides and skins were immersed in a tanning solution made up of 38 liters of rain water, ten liters of common salt and 442 cubic centimeters of concentrated sulfuric acid. The weights of the lighter hides immersed in this solution were from 114 to 4200 grams; of the heavier, from 10,150 to 10,800 grams. As may be seen in table 4, the lighter hides tanned in 24 hours, while the heavier

TABLE 4

Results obtained with salt-sulfuric acid method of tanning (Foreign Method No. 2)

HIDE NO.	WEIGHT OF RAW HIDE	WEIGHT OF TANNED HIDE	LOSS IN WEIGHT		DURATION OF			
					Soaking in water	Dehairing in lime solution	Deliming in vinegar	Tanning in salt-sul- furic acid solution
Cattle hide No. 1	grams 4200.0	grams 3200.0	grams 1000	per cent 23.81	1 day	13 days 12 hours	1 day	1 day 15 hours
Cattle hide No. 2	10150.0	5354.0	4796	47.23	fresh	14 days	1 day	2 days
Cattle hide No. 3	10800.0	5645.0	5155	47.73	fresh	14 days	1 day	2 days
Carabao hide No. 1	1000.0	900.0	100	10.00	1 day	13 days 12 hours	1 day	1 day
Goat skin No. 1	114.0	95.0	19	17.41	1 day	9 days	1 day	1 day

ones took twice this length of time, or 48 hours. It is evident that the difference in the length of time consumed was because the tanning solution does not penetrate through the thicker hides as readily as through the thinner ones. Examination of the hides in the tanning solution showed that the hides gradually became soft and pliable with the flesh color fading. After removing a hide from the solution, however, and exposing it in sunlight the tissues became firm and strong.

Foreign Method No. 3-a and b. "Tanning skins with and without hair"—R. C. Hodgson (Sandhouse, 1922):

The hides without hair were first soaked for six hours in a solution made of 14.2 grams of borax, 250 grams of common salt, and 250 grams of soft soap dissolved in 15.2 liters of water. Three pieces of cattle hide were

used. Examination was made at two-hour intervals, and care was exercised so that the hides were equally and properly acted upon by the solution. After soaking for six hours, the hides turned white and were odorless. According to Rogers (1915), borax acts as a preservative. Thus, the white color and lack of odor of the hides were caused by the borax and salt contents of the solution.

The bleached hides were put in a tanning solution composed of 125 grams of oxalic acid crystal and 736.7 grams of common salt dissolved in eight liters of water. The hides were examined every morning, noon, and afternoon. In two days the different hides were found to be more pliable and whiter than before soaking them in the solution. Rogers (1915) states that oxalic acid is also a bleaching agent; hence, the whiter color. As may be seen in table 5-a, hides weighing less than one kilogram tanned in a shorter period of time than those weighing six kilograms or more.

Before the skins with hair were put in the tanning solution, they were soaked from six to eight hours in a solution made by dissolving 50 grams of green soap, three grams of borax, 50 grams of common salt and four and two-tenths cubic centimeters of concentrated sulfuric acid in three liters of water. Goat and dog skins were used. The skins were examined at two-hour intervals. At the end of six hours with the dog skin and eight hours with the goat skins, the hair was observed to be so firmly fixed that it was hard to pull off. According to Sandhouse (1922) the fixation of hair in the skins is caused by the presence of sulfuric acid in the solution. The goat and dog skins just referred to were afterwards immersed in a tanning solution. This solution was composed of 125 grams of oxalic acid and 736.7 grams of common salt dissolved in eight liters of water. The skins were inspected three times a day. At the end of two days they were found to be completely tanned. The leather produced by this method was soft and pliable.

TABLE 5-a

Results obtained with salt-oxalic acid method of tanning hides without hair (Foreign Method No. 3-a)

HIDE NO.	WEIGHT OF RAW HIDE	WEIGHT OF TANNED HIDE	LOSS IN WEIGHT		DURATION OF				
					Soaking in water	Dehairing in lime solution	Deliming in vinegar	Softening in salt-soap solution	Tanning in salt-oxalic acid solution
	grams	grams	grams	per cent	day	days	day	hours	
Cattle hide No. 1	800.0	400.0	400	50.00	1	12	1	6	4 hours
Cattle hide No. 2	6000.0	3300.0	2600	43.33	1	13	1	6	2 days
Cattle hide No. 3	7600.0	3780.0	3820	50.25	1	12	1	6	2 days

TABLE 5-b

Result obtained with salt-oxalic acid method of tanning skins with hair (Foreign Method No. 3-b)

SKIN NO.	WEIGHT OF RAW SKIN	WEIGHT OF TANNED SKIN	LOSS IN WEIGHT	DURATION OF	
				Hair preserv- ing solution	Tanning in salt-oxalic acid solution
	grams	grams	grams	hours	days
Goat skin No. 1	200	200	0.0	8	2
Goat skin No. 2	300	300	0.0	8	2
Goat skin No. 3	328	328	0.0	6	2
Dog skin No. 1	600	600	0.0	6	2

Quality of tanned hides obtained by the different methods

Table 6 shows the quality of leather produced by the different methods of tanning. From the data there given the salt-alum method appears to be the best method, the leather obtained being very satisfactory. The tanned hides were bleached, odorless, hard and firm in texture. The hardness and firmness of the tanned hides were the result of the alum-ammonium content of the tanning material. The leather obtained with this method is slightly better than tanned hides obtained with the salt-sulfuric acid method, in so far as the permanency of the tanning effect is concerned.

With the salt-sulfuric acid method, as may be seen in table 6, the tanned hides were quite satisfactory, but not so good as those obtained with the salt-alum method. However, the leather produced by this method was soft and pliable and bleached and had no disagreeable odor. The main objection to this method is that the tanned hides absorbed moisture which induced fungi to grow and so damaged the leather after a time. In this condition there is a tendency for the leather to become very soft. The same observation was reported by Frey, Clarke, and Veitch (1922).

The tanned hides obtained with the salt-oxalic acid method of tanning without hair were bleached, hard and firm in texture, but those tanned with hair were very satisfactory. They were pliable and soft, and had no bad odor. The hair of the tanned hides with this method adhered as firmly as though the hides were in fresh condition.

The poorest quality of hides was produced by the native method. The product was dull light brown in color, loose in texture and with a disagreeable

odor. The light brown color in the tanned hide was caused by tannin that stained the hides.

TABLE 6
The quality of leather produced by different methods of tanning

METHODS	QUALITY OF LEATHER
Foreign method No. 1 Salt-alum	Best, bleached, odorless, hard, and firm in texture.
Foreign method No. 2 Salt-sulfuric acid	Good, bleached, odorless, soft, pliable; absorbed moisture.
Foreign method No. 3 Salt-oxalic—a	Medium, bleached, hard, firm and odorless.
Salt-oxalic—b	Very good, pliable, odorless, hair adhered firmly on the skin.
Native method	Poor, dull light brown, loose in texture, and with a disagreeable odor.

Loss in weight of tanned hides

In all the methods employed, the tanned hides, excepting those tanned with hair, lost much in weight. This difference may be attributed to the loss of hair, fatty and connective tissues, flesh, and other extraneous matter that were removed in dehairing, fleshing, and cleaning processes. There were also losses in the substances dissolved in the tanning solution. Table 2 shows that the loss in weight of tanned hides produced by the native method varied from 14.75 to 31.67 per cent, excepting in goat skin No. 5 where the loss in weight was only 4.43 per cent. This skin was extremely dry and well fleshed out before it was tanned. The average loss in weight of tanned goat skin was 21.99 per cent; of cattle, 31.67; and carabao, 14.75.

Table 3 shows that the loss in weight of cattle hides tanned by the salt-alum method was 45.53 per cent; of goats, 58.75 per cent. The average loss in weight with the salt-sulfuric acid method was 39.59 per cent for cattle hide; 10 per cent for carabao hide; and 17.41 per cent for goat skin. The average loss in weight with the salt-oxalic acid method was 47.86 per cent with cattle hides.

Of the four methods of tanning employed, the greatest average loss in weight, 47.86 per cent, was obtained with cattle hide tanned with the salt-oxalic acid method. The second greatest loss in weight, 45.53 per cent, was obtained with cattle hide tanned with the salt-alum process.

In tanning goat skins with the native, salt-alum, and salt-sulfuric acid methods, the highest loss, 58.75 per cent, was obtained with the salt-alum

method; the second highest average loss, 21.99 per cent, with the native method.

All skins tanned with the salt-oxalic acid method with the hair on, lost no weight at all (see table 5-b). These skins were cleaned and well fleshed out before putting them in the tanning solution.

Comparative cost of tanning hides

As may be seen in table 7, the total cost of tanning chemicals and other materials used in tanning one kilogram of hide with the different methods are as follows: ₱.46 with the native method; ₱.43 with the salt-alum method; ₱.17 with the salt-sulfuric acid method; and ₱.73 with the salt-oxalic

TABLE 7

The cost of tanning materials and labor to produce tanned hide by different methods

METHOD	NUMBER OF PIECES OF TANNED HIDE	WEIGHT OF TANNED HIDE	COST OF TANNING MATERIALS		LABOR COST		TOTAL COST OF TANNING MATERIALS AND LABOR	
			Total	Average per kgm.	Total	Average per kgm.	For all hides	Average per kgm.
		<i>kgm.</i>	<i>pesos</i>	<i>pesos</i>	<i>pesos</i>	<i>pesos</i>	<i>pesos</i>	<i>pesos</i>
1. Native	7	7.6352	3.54	0.46	1.44	0.19	4.98	0.65
2. Salt-alum	2	6.0000	2.56	0.43	0.89	0.15	3.45	0.57
3. Salt-sulfuric acid	5	26.2640	4.58	0.17	1.85	0.07	6.43	0.24
4. Salt-oxalic acid	7	15.2285	11.12	0.73	2.86	0.12	13.98	0.85

acid method. It is evident that the cost of material to tan hides by the native method is greater than by the salt-alum and salt-sulfuric acid methods but lower than by the salt-oxalic method, which is highest in cost of tanning materials. The lowest cost of materials was obtained with the salt-sulfuric acid method.

The labor cost was computed on the basis of one peso a day of nine working hours. According to table 7, the labor costs of tanning one kilogram of hide are as follows: ₱.19 with the native method; ₱.15 with the salt-alum method; ₱.07 with the salt-sulfuric acid method; and ₱.12 with the salt-oxalic method. According to these figures, the labor cost with the native method is the highest. With the foreign methods, the salt-alum method gave the highest labor cost per kilogram, but the most satisfactory quality of product was obtained by this process. The salt-sulfuric acid process gave the lowest labor cost.

Net returns accruing from tanning hides

Table 8 shows that the costs of one kilogram of tanned hide are as follows: ₱1.25 with the native method; ₱1.18 with the salt-alum methods; ₱0.75 with the salt-sulfuric method; and ₱1.50 with the salt-oxalic acid method. It follows that the cost of tanned leather is greater with the

native method than with the foreign methods, excepting the salt-oxalic acid method; that is, to tan by the native method is less economical than by the salt-alum and salt-sulfuric acid methods. Besides being cheaper the two last named methods give a better quality of tanned hides. Considering all the methods, tanning by the salt-sulfuric acid process is the most economical, and by the salt-oxalic method the most expensive of the methods used in this experiment.

From an investigation on prices of leather made by the writer on November 16, 1923, at the Philippine Tannery, Malabon, Rizal, one kilogram of the poorest quality of tanned hide produced in this establishment was ₱1.80. With this quotation as a standard (see table 9) the highest gain, ₱1.05 per kilogram of leather, was obtained with the salt-sulfuric acid method. The second highest, ₱.62, was with the salt-alum process. The least gain, ₱.30, was obtained with the salt-oxalic acid method. The native method gave a return of ₱.54, although the greatest labor expense was incurred in its production.

TABLE 8
The net returns accruing from the different methods of tanning

METHODS	WEIGHT OF RAW HIDE	INITIAL COST		SELLING PRICE OF TANNED HIDE	NET GAIN	
		Cost of raw hide	Cost of tanning		Total	Per kgm. of hide
	<i>kgm.</i>	<i>pesos</i>	<i>pesos</i>	<i>pesos</i>	<i>pesos</i>	<i>pesos</i>
Native	7.6352	4.60	4.98	13.74	4.16	.54
Salt-alum	6.0000	3.65	3.45	10.80	3.70	.62
Salt-sulfuric acid	26.2640	13.15	6.43	47.28	27.70	1.05
Salt-oxalic acid	15.2285	8.85	13.98	27.41	4.57	.30

SUMMARY AND CONCLUSION

It is not the intention of the writer to claim that the results obtained in this work are comprehensive and final. But it is certain that the present investigation indicates the practicability and possibilities of this particular line of work. It should stimulate greater interest in carrying out more extensive experiments along the same line.

The principal observations in this work were:

1. Cattle hides were found to cure well in five days.
2. It required practically the same length of time, 11 to 12 days, to remove the hair from cattle and carabao hides; it took seven days with goat skins.
3. Two days were required to remove the lime from the hide with the native method. With the foreign method, using vinegar, the lime in the skin was removed in only one day.

4. By the native method it took six days to tan goat skin; 25 days with cattle hide; and 34 days with carabao hide. Of the foreign methods: with the salt-alum method, cattle hide tanned in 26 days and goat skin in 12 days; with the salt-sulfuric acid method, cattle hide tanned in about two days and a carabao hide and a goat skin in one day; with the salt-oxalic acid method, cattle hide without hair generally took two days and goat and dog skins with the hair on, two days also.

5. The best quality of leather produced was by the salt-alum method; next best, by the salt-sulfuric acid method and salt-oxalic method-b. Leather produced by the oxalic acid method-a was medium in quality, while the poorest kind was obtained by the native method.

6. The lowest percentage of loss in weight was with leather produced by the salt-sulfuric method and the highest percentage was by the salt-alum method. Skins tanned with the hair on did not lose in weight.

7. The lowest total cost of tanning materials was obtained with the salt-sulfuric acid method and the highest cost was with the salt-oxalic acid method.

8. The lowest labor cost in the production of leather was by the salt-sulfuric acid method, and the highest by the native method.

9. The highest gain was obtained with the salt-sulfuric acid method, and the lowest was with the salt-oxalic method.

10. Although the cost of production of leather by the salt-alum method was not the lowest, yet because of the good quality of product obtained by this method it is safe to say that the highest net gain could be obtained by this method.

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ABSTRACT¹

The effect of leaf cutting upon the production of rice. ISIDORO ANDAYA. (*Thesis presented for graduation, 1926, from the College of Agriculture, No. 255; Experiment Station contribution No. 458*).—The object of the author was to find the effect upon the yield of rice in grain, straw, and number of panicles produced: (a) when part of the leaves of rice were cut at different ages; (b) when part of the leaves were cut more than once at different ages.

The experiment was carried out in a rice paddy at the College of Agriculture for almost seven months in the year 1926. The paddy was divided into 15 sets of culture plots. Each plot had an area of 39 square meters and was rectangular in shape. The paddies were prepared in the usual manner. The seedlings of Murmuray, a lowland variety of rice, were used, allowing one seedling in a hill which were at a distance of 2.5 cm. each way. After transplanting, each plot was given the same cultural treatment throughout the progress of the experiment.

The results show that the first method employed prolonged the flowering stage when the leaves were cut when the plants were from 65 to 67 days old, but it gave slight effect if the seedlings treated were younger. The weight of the panicles was also found to be greater than those of either the check plots or the plots treated with cutting part of the leaves more than once at different ages. However, the age for cutting the leaves that gave the greatest yield was when the seedlings were 37 days old, beyond this age there was a gradual decrease of yield, weight of straw, and number of fruiting culms. The repeated cuttings, or the second method employed, caused the maturation of the plants to be more uniform than in the single cutting treatment. The yield of grain was greatly reduced, inasmuch as a fewer number of fruiting culms were produced by the plants.

The single cutting produces from 58 to 91 bales of rice hay to the hectare; the repeated cuttings, from 51 to 95 bales. The calculation was made, considering one bale of rice hay to be equal to one bale of American wheat hay that weighs 74 kilograms. One bale of rice hay with grain costs ₱5.00 in Manila. From this approximate cost, the value of rice hay from one hectare of the different varieties of rice in the Philippines varied from ₱37.00 to ₱640.50.

—Abstract by V. C. Lopez.

¹Abstract prepared as part of required theme work in English 6, College of Agriculture.

EXTENSION DIVISION NOTES

Regarding the New College Copra Drier

Mr. P. Zimmerman, Plantation Manager, Cabano Coconut Estate, Inc., at Jordan, Guimaras Islands, Iloilo, reports that under his own direction a copra drier was recently built in the Estate to replace the old type drier generally used in the Islands. In building the new drier, Mr. Zimmerman followed exactly the plan and specifications explained in detail in the College Experiment Station Circular No. 11, but used more costly materials so as to make his drier more solid and more durable than the one constructed at the College. He spent ₱1,500 for the whole outfit which includes the drier and the shed for protection, as against ₱282.05, the cost of one of permanent type estimated on the basis of local prices by the College for a drier of 1,000 nut-a-day loading capacity. Mr. Zimmerman expresses his satisfaction with the result of his new drier as he now can make copra of higher quality than formerly and can do the work at any time of the year, regardless of weather changes. Formerly, as his report says, it was not possible for him with the use of the old native drier to produce so good a quality of copra, and when he resorted to sun drying he found this process to be expensive and not dependable on account of the uncertainty of the weather. Thus far he has dried 65,050 nuts in his new drier, which under Iloilo conditions gave him 240.75 piculs of copra.

Under the supervision of Prof. Hilarion Henares of the Chemistry Department, College of Agriculture, two copra driers were set up at Lucena, Tayabas, for the Provincial Board of the same province on the initiative of Governor Perez. An adequate appropriation for this purpose was made by the Provincial Board. The construction of the driers was under the immediate direction of District Engineer Bagtas who reported that the drier for which cheap material was used cost ₱268.61 and the other one made of stronger material cost ₱594.57, and the shed—as the driers were built side by side one did for both—had cost ₱562.39—or a total of ₱1,425.57. This amount includes expenses for material, labor and supervision and surcharges of the province. No report has been received from Governor Perez on the actual test made of these driers.

The other copra drier reported to have been set up following the College demonstration is the one on the *hacienda* of Mr. Leon Katigbak in the barrio of Tijero, Lipa, Batangas. This drier is intended by Mr. Katigbak for a trial in drying peanuts, as he has found it difficult to dry them when harvested on rainy days. At the same time it will serve as a model for

Lipa farmers who are interested in building one for themselves for copra making.

There have been several requests received from farmers in other coconut-producing districts in the Philippines to supply them a College specialist to personally direct the construction and operation of the College New Copra Drier. These requests were from Mindoro, Masbate, Albay, and Lanao. But lack of proper personnel has made it impossible to meet these requests as early as was desired. However, copies of the College Experiment Station Circular No. 11, and further explanation of the plan and specifications were furnished the interested parties so as to enable them to set up the drier by themselves.

Quite a number of personal visits were made by various farmers from the different parts of the Islands to examine the drier on the College Campus. These particular farmers found this practice to be helpful to them in following the specifications contained in Circular No. 11. Any one so interested is welcome on the College Campus. It is understood that the same reception will be given farmers who may wish to visit any of the privately owned driers mentioned above.

We know that the invention and the demonstration of the College Copra Drier last year was not a turning point in the improvement of Philippine copra, but from the demands we receive from farmers for information regarding the College Improved Drier we can claim that we have kindled the interest of the Filipino coconut grower in improving the quality of Philippine copra.

A Girl Farmer

During a recent trip to the island of Leyte by two professors from the College of Agriculture studying agricultural conditions in that island, they met on an outlying abaca plantation—out in the country of the barrio of Alahag, Jaro, Leyte—a girl by the name of Rosa Trota. The attention of the party was particularly attracted by the hard task being performed by the girl. Clad in a simple European dress of the ordinary school fashion, squatting barefooted with a bolo scabbard tied around her waist, she was cleaning with a bolo an abaca plantation from weeds that had overgrown since the last harvest. In answer to inquiries, she told the party in fluent English that the plantation belonged to her family and that she was working as hard as she could in order to set the right example to a bunch of men whom she hired to help her clean the plantation. She is twenty-one years of age, is a third year student in the Normal Department of the Leyte High School. Her father being dead, as the eldest of the family she has to take her father's place in farm work so as to aid her mother in providing the living for the family from their land resources. The family has a piece of rice land and an abaca plantation from which they derive their income. The raising of the crops has fallen largely on Rosa's shoulders as

her mother is occupied with household tasks and the business side of farm management.

At the time of the professors' visit was the school vacation and Rosa was using the days putting her abaca plantation in good shape. When the school is in session she uses her school holidays in looking after the rice crop and such other farm work as does not interfere with her studies. It is said that owing to her unusual activities in local farming—managing as well as performing actual farm work—she has been offered by government officials an appointment as agricultural agent. But she has not made up her mind to accept a government job as her studies as well as the farm work are absorbing all her attention, and there is no one in her family, except her mother, old enough to run their farm business.

Regardless of the fact that Miss Trota had to do the work because she had lost her father, still her eagerness and ability to do what is generally looked upon as a man's job are quite appealing. Her example is one that might well be emulated by many of our students who return home every long summer vacation for a rest from their school work. Such a rest may be but a change of work which together with occasional merry-making affairs will surely make for a worth while and profitable relaxation from a year's work in school or college.

Two Former Students of the College of Agriculture

During the trip to Leyte of the two professors mentioned above, Mr. Mauro G. Rodriguez and Mr. José Mendoza, two former students of the College were met. They are both from Pangasinan and are employed by the Bureau of Agriculture for the province of Leyte as Agricultural Extension Agents. Mr. Rodriguez is in charge of extension work for the whole province and Mr. Mendoza is in charge of the Provincial Experiment Station located at Jaro, Leyte. It is interesting to note that while their salary is borne by the Insular Government, their traveling expenses as well as the expenses of the provincial experiment station are met by the province of Leyte. Provincial government officials, particularly the governor of Leyte, speak very highly of the work of both employes as of great benefit to the province. Mr. Rodriguez has traveled throughout the province to study local agricultural conditions and to help farmers solve some of their local problems. The Provincial Board has given him an office in the provincial building and depends upon him for advice in agricultural matters. Mr. Rodriguez is credited with originating Administrative Order No. 52 "containing regulations governing the removal and disposal of sawdust, manure, decaying stumps of coconuts and buri palms, bagasse and other vegetable matter or rubbish, and declaring the black beetle (*Oryctes rhinoceros*) to be a dangerous plant pest". It was mentioned that the issuance of this order started with written suggestions given by Mr. Rodriguez to the Municipal Council of Abuyog, Leyte, which in turn embodied them in a municipal

resolution sent to the Governor General in 1925. Mr. Mendoza is principally engaged in propagating plants at the Provincial Experiment Station for sale to farmers or for co-operative work with them in large plantings.

Mr. Rodriguez stayed at the College as student from 1914 to 1917 inclusive. In his junior year he left the College and went to the Bureau of Agriculture as Junior Agricultural Assistant and held this job for three years. Having saved enough to cover his transportation he went to the United States and entered Montana State Agricultural College as a self-supporting student. While pursuing his course in that college from 1921 to 1924 he was employed first as seed grader in the Seed Laboratory of the Montana Experiment Station and then as student assistant in the entomology and zoölogy department in connection with field work on grasshoppers. He graduated from Montana College as B. S. in Entomology and Zoölogy in 1924 and returned the same year to the Philippines and has been employed by the Bureau of Agriculture as agricultural extension agent since May 15, 1925.

Mr. Mendoza was in the College from 1916 to 1918 as a student. Because of failing health he left College and found a job in the Bureau of Agriculture. First, he was appointed as Junior Agricultural Assistant and then promoted to Agricultural Extension Agent, the position which he is now holding. He is planning to come back to the College to finish his course.

Fruit Preservation

The Bureau of Science should be commended for the success of its food preservation campaign. It is not uncommon now to see stores of preserved fruits, which in the past would have gone to waste, in many Filipino homes. Some are deriving income from sale of preserved fruits. In large towns home-made-preserves are for sale in many stores. Recently an *hacendero* from Batangas who is sending his preserved fruit to Manila, borrowed a sterilizer from this College to be used in food preservation. All these activities are the result of the campaign conducted by the Bureau of Science. For the first time in the history of the country fruit is becoming an important commercial product.

In this connection we may note the loss of an important industry in Bataan through the closing of the cannery in that province. For several years a fruit canning factory flourished in Orion, Bataan. They canned many kinds of fruit, but mostly pineapple, mango, and guava, and sent them direct to foreign markets. It was a good advertising medium for Philippine fruit. But the factory was suddenly closed in 1923. No definite information was made known as to the cause of the closing.

EXCHANGE NOTES

Dr. A. F. Woods, director of scientific work of the department, addressed one of the sessions of the Conference on Public Administration which was held in Washington on April 19-20 under the auspices of George Washington University.

The object of the conference was to promote a clear understanding of the policies and activities of the various branches of the Federal Government, and to make available to members of the college and University faculties the funds of information contained in the various departments of the Government.

The holding of such a conference was suggested by Dr. William Mather Lewis, president of the University, and it is the intention to make the conference annual. This first conference was attended by presidents and professors of political science, history, and sociology of some 40 colleges and universities of the country. Many high officials of the Government addressed the delegates on the work of their departments and agencies.

In his address, Doctor Woods gave a thorough outline of the activities of the Department of Agriculture.

"The research project of the States and the Federal Government involve an annual expenditure of about \$20,000,000, about evenly divided between the States and the Federal Government," he said. "The economic returns, so far as they can be measured, are very large, now amounting to more *each year* than the entire expenditure for all the work of the department and the colleges from their *foundation to the present time*".

—*The Official Record* (U. S.).

The Filipinos make five kinds of muscovados. They put it in "Bayons," sacks made out of "buri" which comes from palm leaves. The Chinese buy this a lot and the correspondent saw it in some of the remoter places of the empire, where it had been subjected to dust and dirt and seemed absolutely impossible from an American point of view. Were it not for the inherent goodness of the sugar crystal this product would kill off a lot of people and we are not so sure that this does not happen to consumers of the tainted product. * * *

Twenty per cent of the mills in the Philippine Islands are manned by American capital. American capitalists have rather urged the Filipino to subdue his own land and invest his own money. No people are permanently happy who have to constantly depend on outside capital to work their industries, for the profit motive engenders feelings that do not work for the best relationships and no matter how fair moneyed men may be the sting of this criticism always awaits them.

—*The Planter and Sugar Manufacturer*.

Cheese is one of the oldest forms of food used by man. Its use is probably almost, if not quite, as old as that of wine.

The amount of cheese consumed annually per head of population in New South Wales is about 3 1/2 lb., while in England the consumption approximates 10 lb. per head.

—*The Agricultural Gazette* (New South Wales).

The grape fruit which is a favorite in the United States of America is also fast becoming a popular fruit in other countries of the world. The imports into the United Kingdom were six times as large in 1924 as in 1920, and the demand is continuing to increase. South Africa has taken up the cultivation of grape fruit extensively and is now making, together with the British West Indies, regular exports to the United Kingdom. The growing of grape fruit is also extending in Australia, but the exports up to date are comparatively small, says the Department of Agriculture, *Ceylon, Leaflet No. 41*.

—*Reprinted in The Planter* (F. M. S.).

The use of some preservative will help greatly in the preservation of lumber under fungus-favoring conditions. Painting the interior of a poultry house leads to the elimination of those conditions that stimulate the growth of wood-destroying fungus in a house.

* * * * *

Wood is subject to the attacks of various fungi which are living organisms that prey upon the wood fibre.

A better understanding of what wood decay really is would make a poultry-man willing to spend for more paint some of the money that must otherwise be spent in repairs or in building a new house when the old one prematurely decays. It was not age that decayed his buildings—it was the fungi and his own ignorance working as partners.

—*American Poultry Journal*.

Did it ever occur to you that young chicks, like babies, require a lot of sleep? When chicks are brooder-raised, it would be a good plan to remember this and arrange some darkening process by which the chicks would be encouraged to take "40 winks" frequently during the day.

—*Cultivator* (California).

COLLEGE AND ALUMNI NOTES

Professor W. E. Hoffman, head of the biology department of Canton Christian College, was a Campus visitor during the greater part of July. He is conducting investigations on the water bugs, numerous interesting forms of which are found in Molawin Creek and other bodies of water near by. Professor Hoffman has done extensive work on these insects in China.

The Department of Animal Husbandry completed the installation of a one-ton ice plant June 13. In addition to ice, pork is now available for sale at the department at all times. A refrigerator will be installed in the near future. When this is completed, other kinds of meat will also be on hand for sale.

Friends of Professor Higgins will be interested to learn that he is now Agronomist of the Panama Canal Zone and working under very favorable circumstances. His address is Balboa Heights, Panama Canal Zone.

The following note about one of our faculty members appeared in *Berkeley Daily Gazette*, April 21, 1927:

The accidental discovery that juice flows from the Para rubber tree in the Philippines when the surface is scratched has led to an exhaustive research on the subject by Dr. Eduardo Quisumbing, associate in botany at the University of California who is on leave from the University of the Philippines where he is assistant professor of plant physiology in the College of Agriculture.

Although the anatomy of rubber trees has been investigated in various countries for years, the fact that tubes containing rubber juice arise almost to the surface of the tree was reported for the first time by Dr. Quisumbing.

Laticiferous vessels, or tubes of rubber juice, occur in the pith in young stems, in seedlings, in the leaves, and also in the roots, according to the reports by Dr. Quisumbing, published by the University of California Press. Such tubes may have two origins in the mature bark: one in the deep cortex, surrounded by a solid, hard portion of the tree known as the "stone ring", the other, outside this stone ring near the surface of the tree. The rubber-giving tubes on one side of the stone ring are totally separated and have an entirely different origin from those on the other side.

The new members of the Department of English staff are Miss Caroline Virginia Lee and Miss Esther A. Anderson. Miss Lee was graduated from Peabody Normal College, University of Nashville, and has been teaching for some years in James Sprunt Academy, Kiangyin, China. Miss Anderson was graduated with degree A. B. from University of California; graduate work in English and history was carried in Summer School, University of Southern California. Miss Anderson has been teaching in San Pedro High School, in Los Angeles School System.

Rev. Hugh Bausman is now resident pastor for Presbyterian Chapel at the College. For the past three years Mr. Bausman has been in charge of a mission on Hainan Island, China.

Dr. Deogracias V. Villadolid reported for duty in the Department of Entomology on June 9. He recently returned with Mrs. Villadolid from the United States where he had been sent as a University Fellow in agricultural zoölogy at Stanford University. He completed the requirements for doctorate of philosophy and in addition sports a Sigma Xi key. He had a chance to visit a number of American and Japanese scientific institutions before his return home.

A United States Army Motor Cycle Corps camped on the Campus two days in June. The Corps was out for training in "hiking" and motor transportation. Lieutenant Aldrich, graduate from the Houghton School of Mines, was in command. He was in the Flying Corps in the War. The Corps under the guidance of Lieutenant Aldrich spent one profitable forenoon in the College laboratories.

The thesis of Mr. Ernesto Montinola, B. S. '27, on "Earle Method vs. Ordinary Method of Treating Ratoons" appeared in the April number of *Sugar News*. In the May number of the same journal appeared articles by Dr. Manuel L. Roxas and Dr. Elias H. Panganiban, both of Department of Agricultural Chemistry. Doctor Roxas reported on "P. S. A. Experimental Work on Luzon" Doctor Panganiban's paper was on "A Few Facts on Symbiotic Nitrogen Fixation."

Mr. Eldiberto Punzalan, B. S. A. '24, graduate assistant in Agronomy, resigned to accept position as assistant agriculturist with the Victorias Milling Co.

Artemio Manza, B. S. A. '23, formerly graduate assistant in Plant Physiology, now studying in University of California, Berkeley, writes Dean Baker of his arrival and welcome by Doctor Quisumbing, his former Chief in the College.

Mr. Dionisio Aquino, B. S. A. '23, now a student in State Agricultural College, Ames, Iowa, writes Dean Baker that he passed the oral examination for Master of Science and is planning for further study in the College. Mr. Aquino requested that seeds of legumes be sent him for work on a problem in cross inoculation that was suggested to him by his major professor.

Mr. Primo San José, B. Agr. '23, now teaching in the Piang Agricultural School, Kударangan, Cotabato, writes Mr. Capinpin of his work and hopes of getting land in that new region. He shows his estimate of the value of the work in the College by sending a younger brother here this year.

Also, Mr. San José sent in his subscription for THE PHILIPPINE AGRICULTURIST.

THE NEW MAN AT THE HELM

On August 26, 1927, the Board of Regents of the University of the Philippines appointed Dr. B. M. Gonzalez acting dean of the College of Agriculture. This action raised to the position of leadership a man who has literally grown up with the institution. Acting Dean Gonzalez first came to this College, with advanced credits from the Philippine Normal School, as a "freshie" seventeen years ago, when Dean Copeland and his handful of faculty members and students were just beginning to carve a college of agriculture "out of wilderness," and graduated three years later. Mr. Gonzalez was subsequently taken on the faculty as assistant in animal husbandry, then promoted to instructorship in 1916, to assistant professorship in 1917, to associate professorship in 1919, and to full professorship in 1920. He was sent twice by the University as a fellow to pursue advanced training in the United States, first from 1914 to 1916, with residence in the University of Wisconsin, where he obtained the degree of master of science and subsequently from 1921 to 1923, at the end of which period he returned to Los Baños with a doctorate of science from Johns Hopkins University. In 1926 he was sent to Japan as one of the delegates from the University of the Philippines to the third Pan-Pacific Science Congress.

Although formally designated head of the Department of Animal Husbandry in 1924, Doctor Gonzalez had virtually been directing this department since 1916. Its present equipment, technical personnel, and highly developed organization, which make Animal Husbandry rank as one of the three largest and most important departments of the College of Agriculture were built up largely through his efforts.

Even in his student days he was engaged in many extra-curricular activities at the College. He held a number of positions of responsibility and trust in the Student Body Organization. He was business manager of THE PHILIPPINE AGRICULTURIST AND FORESTER for many years. As a faculty member he was often intrusted by Dean Copeland and Dean Baker with the performance of difficult, and not infrequently delicate, missions and committee work. As indicative of his leadership among his associates, he was elected the first alumni regent of the University, from 1918 to 1921;

and was the first president of the College of Agriculture Alumni Association and also of the Los Baños Biological Club. He has been vice-president of the Philippine Society of Technical Agriculturists and secretary of the Philippine Agricultural Congress.

Doctor Gonzalez has travelled very extensively, and has visited many institutions having to do with agricultural education in Europe, the United States, and Japan. Although comparatively a young man (only thirty-four), he has now to his credit about thirty scientific papers. He has always stood for service and a high degree of scholarship.

WHAT ARE YOUR ANSWERS—YES OR NO

Agriculture (New Jersey) offers the following questionnaire to farmers:

For success, the farmers of today have found it necessary to consider the following questions:

Have I carefully saved and used all the manure that has been produced on the place?

Have I followed the practice of having seed tested for purity and germination?

Has my land always been thoroughly prepared so that the seed has a fair chance for germination?

Have I given sufficient study to the problems of farm drainage and crop rotation?

Have I estimated how much I might have saved had I put into practice well-known methods of controlling insect and fungous diseases?

Have I been as careful as I might have been in the matter of neatness, and quality and quantity in putting up packages of fruits and vegetables for the market?

Have I studied the fertilizer requirements of my soil with particular reference to the crops that I am growing?

Have I squarely faced the fact that it is contrary to the laws of nature to take from an acre of land, for a period of 20 to 40 years, more plant food than I return to it, if I would have my yields increase rather than decrease?

The farmers who study these questions the most carefully, and act accordingly, are the farmers who survive and succeed.

SCIENCE AS CULTURE

Reprinted from *Science*

The time when a knowledge of the Greek and Roman classics was the hallmark of an educated man has past. To-day, even their cultural value is fast diminishing. To know Eros is nowadays not so important as to know what Freud believes about love. The fire Prometheus stole is less use to us than the energy generated by photosynthesis. Phoebus's chariot has become an internal combustion engine; radio replaces Mercury; the metamorphosis of cellulose into rayon, lacquers, celluloid, artificial leather, explosives and what not transcends the myths told by Ovid. Chemistry, physics and biology are to-day not only "a systematized and co-ordinated body of facts," they are also the tools and the toys of the man on the street. They are at once the subject of erudite monographs by specialists and of common gossip around the tea table. Their laws govern the operation of our factories; their principles are applied in the kitchen; their technical terms have become newspaper jargon. In the marketplace or by his own fireside a man is deaf, dumb and blind without at least a working knowledge of the sciences. They are, as Br'er Rabbit said, "de mos' kulturines' t'ing in de world".—WILLIAM HAYNES.

HONORS

He came to Cornell alone—he went home alone. He came to Cornell a fragile weakbodied individual and went home the same. After four years he had never done anything outside of class-work, not even skating or tobogganing. He knew two students, his roommate and his brother. He was acquainted with three professors, his faculty adviser and two others he had taken work under. But he jangled two honorary keys from his watch chain. They were his reward for four years of sacrifice for mere knowledge, of his time, his money, his health, his pleasure, and his biggest opportunity, to gain experience and to build friendships.

—*The Cornell Countryman.*

METHUSELAH

Methuselah ate what he found on his plate
And never, as people do now,
Did he note the amount of the calorie count—
He ate it because it was chow.
He wasn't disturbed as at dinner he sat
Destroying a roast or pie,
To think it was lacking in granular fat
Or a couple of vitamins shy.
He cheerfully chewed every species of food,
Untroubled by worries or fears
Lest his health might be hurt by some fancy dessert,
And he lived over nine hundred years!

—*Medical Sentinel.*

—From *The Kalends of the Waverly Press* (U.S.A.).

EDUCATION AND AGRICULTURAL PROMOTION IN JAPAN: V. STOCK RAISING¹

B. M. GONZALEZ

*Delegate from the University of the Philippines and the Government of the Philippine Islands
to the Third Pan-Pacific Science Congress*

WITH NINE TEXT FIGURES FROM PHOTOGRAPHS BY AUTHOR

Stock raising is not a Japanese industry of long standing. In the very early centuries of the Empire, farm animals were raised to some extent, but with the spread of Buddhism and Shintoism the use of animal flesh for human consumption became taboo, and later, economic changes decreased the use of animals in agriculture. With the advent of Western influence, however, the bars of religion have gradually been let down and each year shows an increase in the meat consumption of Japan.

The development of stock raising in Japan is permeated with patriotic influence. In the first place, the consumption of meat was stimulated by the belief that the white men of the Occident who opened the doors of Japan to the world trade acquired their size, valor, and enterprise because meat was a part of their diet, and that if the Japanese desired to become as progressive and vigorous they would have to consume animal flesh. They were told that Japanese remained small because they did not eat meat. In their patriotic fervor to hold their own among the peoples of the world the Japanese began to include meat in their diet in spite of their religious teachings.

HORSES

The original horse of Japan was of Mongolian extraction with admixture of Persian blood. It was a relatively coarse big-boned animal a size larger than the Philippine pony. Horses are used for riding and to a limited extent by farmers for draft and as pack animals. At the present time the greater part of the horses are raised in northern Honshu and Hokkaido where the land holdings are relatively large.

During the Boxer trouble in China in 1899, when the army of Japan came in close contact with Western armies, and during the Russo-Japanese war in 1904-05, the Japanese mounts being small, rough, and unruly showed up very badly in comparison with those of other nations. This aroused the authorities to the need of rapidly improving the stock, and in 1906 a Horse Bureau was established² to effect intensively the improvement of the stock.

¹ General contribution from the College of Agriculture No. 190.

² Takenobu, Y. The Japan Year Book, 1926. Year Book Office, Tokyo.

The program called for the placing of 1,500 stallions of foreign breeds for public breeding with the native stock, and an outlay of about 30 million yen to be spent in 28 years.

The government had realized some years before this comparison of military mounts the necessity of improving the horse stock and had in 1895 appointed a commission to study the best means of effecting this.³ The commission recommended the acquisition of promising breeds from different countries and the establishment of stud farms wherein the breeding of stallions of foreign blood might be carried on. Two such farms were established, one in Cichinohe, Aomori prefecture, and the other in Hidaka, Hok-

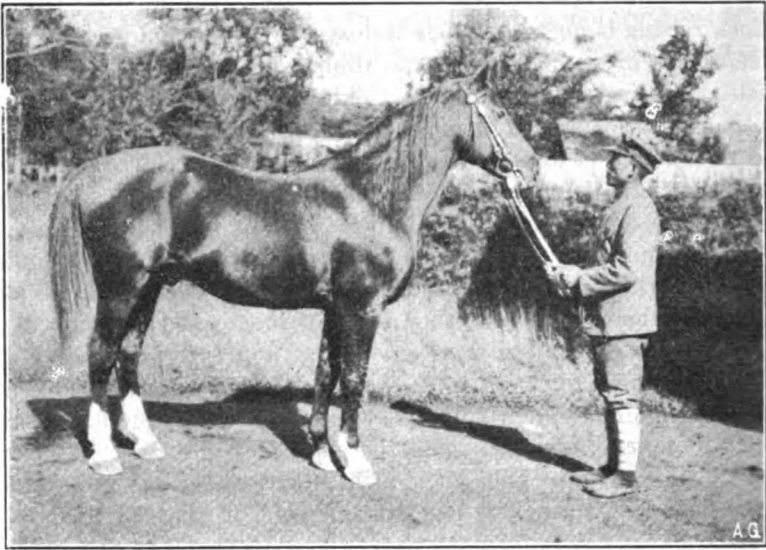


Fig. 1.—O-bajan V-b, an imported Arabian stallion at the O-u National Stud Farm. He cost the government 6,000 Kronen, or ¥2,500. Other stallions range in price up to ¥65,000.

kaido prefecture. Stallion depots or public breeding stations were then to be established in horse breeding centers scattered over the country. There are now twelve such depots.

To give an idea of how the project is carried on, the O-u Stud Farm, which the writer visited, is here described in some detail.

The O-u stud farm was formally established in June 1894⁴ under the Department of Agriculture and Commerce. The farm covers an area of 2,235 hectares and is situated west of Cichinohe town in Aomori prefecture. About one-half the area is rolling land, and the other half an extensive

³Yamawaki. Japan at the beginning of the 20th century. Volume of information prepared for the Louisiana Purchase Exposition at St. Louis, Mo., 1904.

⁴Ban, T. The O-u stud farm. Unpublished manuscript specially prepared for the writer.

plain. The climate is cool in summer and rather cold in winter, reaching to as low as 16° C. below zero. The farm is devoted exclusively to the breeding of light horses and serves as one of the feeder stations to the stallion depots. At the time of the writer's visit the following animals were kept:

BREED	BREED- ING STALL- IONS	BREED- ING MARES	4-YEAR OLDS		3-YEAR OLDS		2-YEAR OLDS		YEAR- LINGS		BELOW 1 YEAR		TO- TAL
			M	F	M	F	M	F	M	F	M	F	
Arabians	2	8	—	—	—	1	—	1	—	7	2	2	23
English													
Thoroughbreds	3	9	—	2	—	—	—	2	3	1	3	4	27
Anglo-Arabs	—	21	—	—	—	2	—	3	8	6	6	4	50
Anglo-Normans	3	54	—	—	—	4	—	11	20	14	15	8	129
Half-breeds	—	34	—	—	—	5	—	4	5	16	7	6	77
Crossbreeds	—	—	—	—	—	—	—	—	—	—	—	1	1
Total	8	126	—	2	—	12	—	21	36	44	33	25	307

The sole function of the farm is to raise breeding animals. The rate of increase has been observed to range from 60 to 70 per cent of the mares kept. Two year old stallions are sent to the National Stallion Rearing Farm at Morioka, Iwate prefecture, for training. The best stallions are kept by the government for use at the public breeding stations. The best mares are retained for breeding in the farm; 70 to 80 per cent of stallions and mares are thus retained. The discarded ones are sold to the public.

The National Stud Farm at Hidaka, Hokkaido, is a station similar in purpose and extent of operation to the O-u stud farm. It also sends its stallions for training to the rearing farm at Morioka.

Stallion depots. There are twelve stallion depots maintained: in Tokachi and Osamambe, in Hokkaido Island; in Aomori, Akita, Iwate, Miyagi, Fukushima, Nagano and Shimane in Honshu Island; and in Kumamoto, Miyazaki, and Kagoshima in Kyushu Island. The specific function of these stations is to maintain stallions for public breeding.

In the early years of the work of horse improvement two experts were sent abroad every year for the sole object of selecting and purchasing breeding horses. These men visited the different countries of the world wherein good horses were likely to be obtainable. Through this work England, France, and Arabia contributed blood to the horse breeding program of Japan. Neither expense nor effort was spared to insure the success of the enterprise.

The following stallions at the O-u Stud Farm were all purchased abroad:

Name	Breed	Origin	Price
Gallon	Thoroughbred	England	£ 2,400
Rushcutter	Thoroughbred	England	£ 2,500
Roideur	Thoroughbred	England	£ 6,500
O'bajan V-b.	Arabian	Hungary	K. 6,000
Wagih	Arabian	Syria	£ 1,135
Saumur	Anglo-Norman	France	Fr. 15,000
Tyrol	Anglo-Norman	France	Fr. 18,000
Filankator	Anglo-Norman	France	Fr. 18,000

How effective the program of horse improvement embarked upon by the Japanese government has been may be judged by the fact that one has great difficulty now in finding a pure native horse. In all his travels in Japan the writer saw only one horse that was apparently of unmixed parentage (see fig. 2). Practically all horses of Japan are now grades of recognized breeds, such as Arabian, Thoroughbred, Standard-bred, Anglo-Norman, Hackney, Clydesdale, etc. Draft breeds have apparently not been as popular in Japan as the light breeds. Good horses are to be found everywhere, so that the Japanese Army is no longer at a disadvantage in so far as mounts

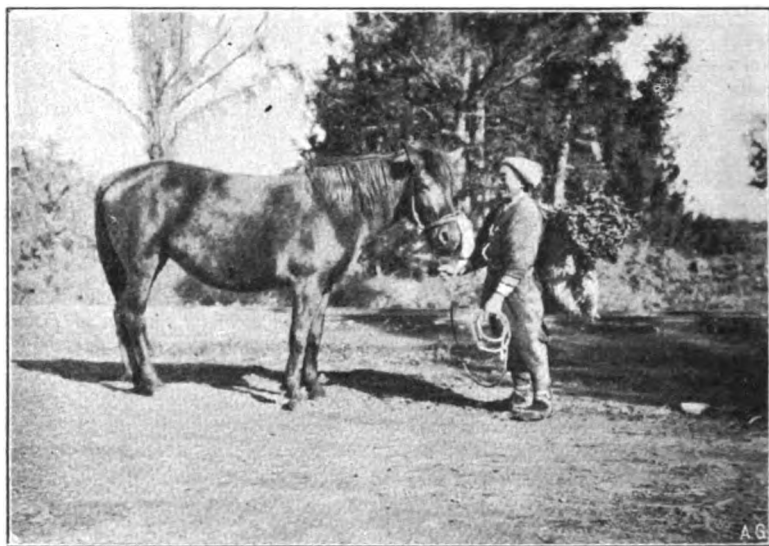


Fig. 2.—A native horse of Japan. It is a big-boned coarse animal, now rarely seen except in isolated districts.

are concerned. Takenobu⁴ states that the army purchases in the open market from four to five thousand horses every year. The average height of the original horse was 4 feet, while at present the average height is 5 feet 2 inches.

A law which aids greatly in improving the horse stock is the compulsory castration of inferior animals. Owners are reimbursed for a part of the cost of the animals disabled or that die as a result of the operation.

Horse racing is a subsidized pastime in Japan with the object of encouraging the breeding of good horses and to develop horsemanship as a healthy sport. Betting is allowed under government supervision. Ten race tracks are in operation.

⁴Takenobu, Y. *loc. cit.*

The usual feeds given to horses in Japan are oats, soybeans, rice bran, carrots, and timothy hay.

Japan had 1,568,685 horses in 1924.

The number of stallions qualified for public service during the same year were:

Foreign, bred locally.....	2,323
Foreign, imported.....	602
Grades.....	2,385
Native.....	32
Total.....	5,342

CATTLE*

The native cattle of Japan are largely of Korean extraction with admixture of Chinese blood. The predominant color of Japanese cattle is

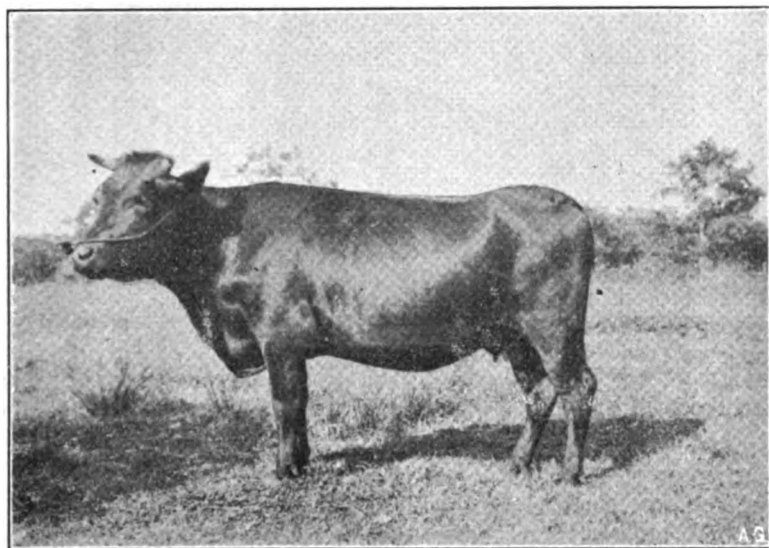


Fig. 3.—A common ox of Japan. It is black in color. Its meat is held in high esteem by the Japanese, who consider it superior to that of foreign breeds.

black. Korean cattle are still being imported into Japan and may be encountered as draft animals in the cities as well as in the country. They are reddish brown in color. The principal animals used for plowing by the farmers in the southern part of Honshu and in Kyushu Island are Korean oxen. The usual practice of the farmers is to buy oxen when the planting

* Abstracted largely from: "The present condition of cattle farming in Japan." Department of Agriculture and Commerce of Japan in Proceedings of the Scottish Cattle Breeding Conference, 1925. Oliver and Boyd: Edinburgh.

season is approaching, use them for plowing, then fatten them and sell them when the work is over. There are farmers who repeat this procedure as often as three times a year. From forty to fifty thousand Korean cattle are imported into Japan yearly.

The proportion of draft cattle fattened and slaughtered for beef is about 65 per cent. The dressing percentage of such cattle is found to be about 49 per cent.

Cows are kept until they are five to eight years old before they are slaughtered.

European breeds of cattle have been imported extensively in Japan, and with their help, in a number of regions, local breeds have been developed particularly adapted to the locality. These breeds are dual purpose, for work and beef. A number of such breeds and the prefectures where they are raised follows:

<i>Breed</i>	<i>Prefecture</i>
Inpaku	Tottori
Shimane	Shimane
Bungo	Oita
Akage-Higo	Kumamoto
Bocho	Yamaguchi
Tajima	Hyogo
Jinseki	Hiroshima
Chiya	Okayama

Japan had 1,456,243 cattle in 1924, and 60,825 dairy cows.⁷

DAIRYING

Foreigners living in the principal trade centers have created a demand for milk. Foreign breeds, such as Devon and Shorthorn, were imported for this purpose at first. Later, Holsteins, Ayrshires, and Jerseys were brought in in large numbers. Representatives of practically all breeds have been brought in at one time or another, including Simmenthals, Brown Swiss, Guernseys, and French Canadians. While the Department of Agriculture initiated the importation of dairy breeds, individuals later took hold of it and of late private importations have been very frequent. The government encourages the bringing in of high class breeding stock by remitting the import duties on such animals as pass inspection. This duty amounts to ten per cent *ad valorem*.

Of all imported breeds in Japan, Holsteins are now the most numerous. This is because they are heavier yielders than other breeds and are therefore preferred. Ayrshires come next in number. They have the reputation of being hardier than the Holsteins and their calves easier to raise. The

⁷Section of statistics. 1926. The statistical abstract, Department of Agriculture and Forestry. Tokyo, Japan.

United States is the usual source of improved dairy stock, although occasional animals come direct from Canada, Australia, and Holland.

The dairy industry of Japan was greatly stimulated during the World War. Condenseries were established in many places, thus affording an outlet for the milk produced. There were at the time of the writer's visit, October 1926, twenty-two condenseries. The largest ones were in Hokkaido; and a number of smaller ones were in the prefectures close to Tokyo.

There are only a few creameries in Japan, for the demand for butter is limited to the larger cities wherein foreigners reside.

As pointed out in a previous article,⁸ Japanese land holdings are very small, and dairy farms, while considerably larger than the usual farm, are no exception. In Hokkaido, where the farms are larger than in the mainland, the average holding of the dairymen around Sapporo is five hectares, and they keep three to four cows on that.



Fig. 4.—The first and only co-operative creamery in Japan.
It is run by a graduate of an American university.
Near Sapporo, Hokkaido.

The average yield per cow in 1922 was 3912 pounds (1774.4 kgm.). The average yield of 110 Holsteins registered at the Central Association of Animal Industry is as follows:

Milk.....	16,827.7 lb. (7632.5 kgm.)
Fat.....	613.7 lb. (278.4 kgm.)

It is claimed that two cows of Japan have beat the world's record for milk and butter fat production which has been held by the recognized world's champion dairy cow, Melba 15th of Darbalara, an Australian-

⁸ Gonzalez, B. M. 1927. Education and agricultural promotion in Japan: IV. Promotion of agriculture. *The Philippine Agriculturist* 14: 67-71.

bred Shorthorn, which produced in a 12-month period 32,522 pounds (14,751.7 kgm.) of milk yielding 1614 pounds (732.2 kgm.) of butter fat.⁹ These Japanese champions are Holstein cows: Frins Anna Roland with a record of 37,923.3 pounds (17,201.5 kgm.) of milk with 1827.1 pounds (828.8 kgm.) butter fat and Ellen Pietertje Granson with a record of 41,112.6 pounds (18,684.3 kgm.) of milk and 1,793.1 pounds (813.3 kgm.) of butter fat.

The usual feeds given to dairy cattle are: soybean cake, crushed oats, imported wheat bran, malt sprouts, linseed meal, green pea meal, beet pulp, and silage of corn and *Astragalus sinicus*.

In addition to the exemption from import duty of superior breeding cattle, the government attempts to encourage cattle farming in other ways. Bulls standing for service are first inspected and licensed. The certificate is good for only one year, except when the animal is exceptionally good, when it may be issued for three years. In 1922, 6292 bulls were thus licensed. They were of the following breeds:

Native breeds.....	3,443
Korean.....	78
Holstein.....	1,851
Holstein grades.....	355
Ayrshire.....	189
Ayrshire grades.....	14
Shorthorn.....	84
Shorthorn grades.....	130
Other pure breeds.....	40
Other grades.....	108
Total.....	6,292

The government also grants prize money and medals for live stock shows and subsidizes breeders associations maintaining herd books of pure breeds. At present herdbooks for the Holstein, Ayrshire, and Jersey breeds are maintained. It is also proposed to open herd books for native dual purpose breeds of work and beef.

SWINE

The Japanese have not included pork in their dietary to the extent that they have beef; in fact it is eaten very seldom. Because of this, hog raising is not popular, although it could be. In a country where rice is the staple the amount of rice bran produced must be considerable, and this can well be the basic feed in hog rations. As it is, considerable amounts of rice bran are turned back to the land direct in the form of fertilizer.

In some of the prefectures of the south, which, due to proximity, have long had constant trade relations with Korea and China, the consumption of pork is more general.

⁹Sanders, A. H. 1925. The taurine world. The National Geographic Magazine 48: 591-710.

The government has not neglected the promotion of the hog industry, although it has not done as much for it as it has for other live stock. Improved breeds are maintained on the government stock farms, as the Zoö-technical Experiment Station in Chiba, and Makomanai Cattle Breeding Station near Sapporo. The breeds represented are Yorkshire, Berkshire, Duroc Jersey, and Poland China—all coming from America.

A swine product which has gained merited favor is Kamakura ham. This is a mild sugar cured ham. A greater part of the product is exported to China.

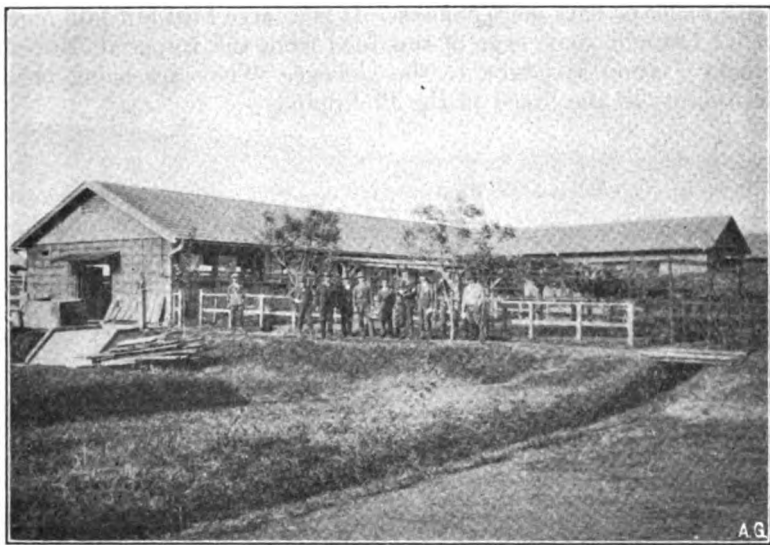


Fig. 5.—Swine yards at the Imperial Zoötechnical Experiment Station, Chiba. Members of the Station staff in the foreground.

POULTRY

Chickens are kept in small numbers on farms and around village homes. It may be said that specialized poultry farms are not to be found. The government has stimulated poultry raising by imposing a heavy tariff on imported eggs. At first this was ten per cent, then it was raised to twenty, and now stands at fifty. Formerly, Japan imported large quantities of eggs from China, but through the operation of the tariff this has decreased considerably.

One is astonished to find how common imported breeds of fowls are, especially White Leghorns and Barred Plymouth Rocks. There are also

some Rhode Island Reds, Black Minorcas, and Brown Leghorns. In 1925 the number of birds was as follows:

<i>Breed</i>	<i>Number</i>	<i>Per cent</i>
White Leghorn.....	8,028,700	22.5
Nagoya.....	7,796,200	21.8
Barred Plymouth Rock.....	1,447,700	4.1
Black Minorca.....	819,400	2.3
Brown Leghorn.....	550,000	1.5
Crossbreeds.....	13,865,100	38.8
Others.....	3,231,500	9.0
Totals.....	35,738,600	100.0

For the most part, the foreign breeds were imported from the United States. The Nagoya is the common native fowl of Japan. It is buff in color with black or dark slate shanks. It is a large bird but late maturing. The writer brought some eggs of this fowl from the Imperial Zootechnical Experiment Station at Chiba to the College. They are being tested for the adaptability of the breed to the Philippines.

SHEEP

This is the latest stock industry that has received government stimulation. Great difficulty was experienced during the World War in getting a steady supply of wool for the use of the country and the army. The government realized the necessity of providing a home supply of this important product, and accordingly in 1918, 330,000 yen was voted by the Diet for the purchase of breeding sheep in Australia, England, America, etc.¹⁰ Most of these sheep were kept in government stations for propagation; a few were turned over to farmers direct. A farmer raising sheep is given a subsidy of five yen per head of sheep kept on his farm. Since 1919 an appropriation of 460,000 yen has been set aside every year for the importation of 1000 head of breeding sheep.

Two sheep breeding farms were established in Hokkaido for the purpose of furnishing breeding stock to the farmers in the future. One of these is here described in detail.

The Tsukisappu Sheep Breeding Station. This station was established in 1923 and is located a few miles out of Sapporo. The farm has an area of about 1500 hectares and is devoted exclusively to the raising of sheep. The following animals have been imported and are at present raised on the farm:

<i>Breed</i>	<i>Origin</i>	<i>Number</i>
Rambouillet.....	America.....	719
Corriedale.....	Australia.....	542
Merino.....	Australia.....	176
Ost-Friesian (milk).....	Germany.....	133
Romney Marsh.....	England.....	81
Romanovski (wool).....	Russia.....	37
Shropshire.....	England.....	34
Cheviot.....	England.....	22
Southdown.....	England.....	3
Crossbreeds.....		34
Total.....		1,701

¹⁰ Takenobu, Y. *loc. cit.*

The station has an annual appropriation of about 110,000 yen.

The feeds used for the sheep are wheat bran, crushed oats, pea meal, pumpkins, and pasturage. The different breeds of sheep are kept separate in sixteen barns. A station similar to this one in importance and extent of operations is maintained in Takikawa, Hokkaido.

This is not the first time that Japan has attempted to raise sheep. The earlier attempts were on a minor scale, however, and failed on account of the prevalence of disease. A provision is now made for regular veteri-



Fig. 6.—Imported sheep at the National Sheep Farm, Tsukisappu, Hokkaido.

nary inspection of flocks at government expense. It is evident that no efforts are spared to establish the sheep industry in the country. The government spends annually approximately one million yen for the development of sheep raising.

The progress being made may be roughly judged by these figures:

<i>Number of sheep in Japan</i>	
1914.....	2,771
1915.....	2,768
1916.....	3,370
1917.....	3,192
1918.....	4,546
1919.....	4,683
1920.....	8,519
1921.....	9,741
1922.....	11,384
1923.....	14,950
1924.....	15,710

The year 1919 marks the period when the government took definite steps to establish the sheep industry in the country.

In talking over the sheep situation with a number of Japanese, the writer found many who were skeptical as to the outcome of the government efforts. Knowing what has been accomplished with other live stock industries and knowing the patriotic zeal of the people, the success of the enterprise seems assured. It is true that the small-sized farm holdings are not well adapted to sheep raising, but so long as no fundamental difficulty, as unfavorable climate, exists in certain regions, it seems perfectly possible for farms in these places to so adjust their operations as to include sheep. As the sheep enter into direct competition with other animals and with crops that are likely to be more profitable, it may be necessary to continue the government subsidy indefinitely. There is already one breeder who has 300 head at Nemuro, but the small farmers keep only four or five head.



Fig. 7.—Cattle barn in Hokkaido. The type of farming in this northern island of Japan is American, adopted largely from Wisconsin's dairy farms.

THE IMPERIAL ZOÖTECHNICAL EXPERIMENT STATION

Worthy of mention in connection with the development of the live stock industry of Japan is the Imperial Zoötechnical Experiment Station at Chiba. A few notes from the prospectus of the station follow:

In 1900 a cattle breeding farm was established at Nanatsukahara, Hiroshima prefecture, for the purpose of improving the native breeds of cattle. The program was to import British and Swiss breeds of cattle, propagate them, and distribute bulls for the grading up of the common stock.

By 1910 three other stations of a similar nature were established in other parts of the country and they included in their work, besides cattle, swine, goats, and poultry. In 1916 the government realized the need of a research institution to solve, definitely, problems of the live stock industry rather than to just produce animals for breeding purposes. To fill this

need the Imperial Zoötechnical Experiment Station was established. The four cattle breeding stations were converted into branch stations. Later, in 1924, all the branch stations were closed because of financial stringency.

The station as it exists at present has an area of 65 hectares, more than half of which is under cultivation. It has 157 buildings and enjoys a yearly appropriation of 300,000 yen. In addition to doing research work, it distributes improved breeding stock to the public by sale, or by loan to accredited associations. It also takes a limited number of students for training in the technique of manufacturing dairy and meat products. The work is divided into four divisions: animal husbandry, poultry and bee culture, dairy and meat products, and chemistry. It maintains a staff of ten re-



Fig. 8.—The common cart in Central and Southern Japan. The driver does not ride in the cart, so the ox can pull a heavier load. Photograph taken at Fukuoka, Kyushu Island.

searchers and sixteen assistants. Its animal equipment consists of the following:

Cattle (Holsteins, Ayrshires, Angus, Japanese, and grades).....	85 head
Horses, for work.....	14 head
Goats, (Saanen).....	12 head
Sheep, (Corriedale and Shropshire).....	4 head
Pigs, (Yorkshires, Berkshires, Durocs, Poland Chinas, and Crossbreeds).....	255 head
Rabbits, (Belgian and others).....	60 head
Poultry, (White Leghorns, Barred Plymouth Rocks, Rhode Island Reds, Nagoyas, and Crossbreeds).....	1749
Honey bees, (Italians and others).....	32 colonies

It is proposed to add in the near future breeding horses to the equipment of the station.

Among the research problems undertaken are: relation of conformation to age in dairy cattle, merits of the Holstein-Japanese and Aberdeen Angus-Japanese crosses, value of different swine and poultry crossbreeds,

physiology of reproduction in fowls, effect of illumination and ultra violet rays on laying hens and growing chicks, variation and heredity in the weight of eggs, problems in baby chick and bee transportation, breeding bees for high yield, prevention and cure of swine plague, contagious swine enteritis, animal parasites in general, preparation of starters, manufacture of fermented milk products with a view of skim milk utilization, preparation of ham, bacon, and sausages, pork canning, digestibility and feeding studies, urine putrefaction in barn yard manure, etc.

The station is well equipped for the different lines of work it has undertaken. Considering the few years it has been in operation it has to its credit a very considerable amount of work accomplished, the accounts of which have appeared in the Bulletin of the Imperial Zoötechnical Experiment Station, published by the station, and in the *Japanese Journal of Zootechnical Science*. The staff of the station is composed of well-trained and progressive young men.

OTHER LIVE STOCK PROMOTION AGENCIES

In addition to the agencies for promotion of live stock industries in Japan, mentioned in the foregoing pages, the government stimulates by means of subsidies the formation of breeders' associations, co-operative creameries, condenseries, cow testing associations, and marketing organizations, and the holding of live stock fairs, contributing not only prizes but also judges and lecturers. Each prefecture maintains a live stock farm for the propagation of desirable stock, maintaining males of the different farm animals for public breeding and breeding stock for sale to the public. These farms are partly subsidized by the Imperial government.

GENERAL REMARKS

A study of the development of the live stock industry of Japan cannot help but bring one to the realization that it is all a planned development dictated by the statesmen of the country. Because of this it has been rapid, thorough, and straight to the point, suffering little from wasted efforts due to an indefinite or a wavering goal. It is doubtful whether any other form of government than a benevolent autocracy could have carried on such a consistent program of development. Japan realized that its lack of home supply of various animals and animal products was a menace to its integrity, and forthwith started to remedy the situation. There was little argument about it, no room for quibbling, the country needed it, and the country had to have it. Japan opened her coffers and poured out gold that she might attain the needed development in a decade or a score of years that other countries have with painful slowness acquired in one or two centuries.

There are obvious lessons for us in the Philippines in the experience of Japan: (1) That animal and animal products are vital necessities to an enlightened country; (2) That the development of a live stock industry is a very slow process which can be hurried only within limits and at a considerable expense.

Do we desire a well developed live stock industry for the Philippines twenty-five years, fifty years, or a century hence? The answer lies with our public men, but at the rate in which money is doled out at present in homeopathic doses for this important project, it may take a century or two before we can have an appreciable development.



Fig. 9.—Common type of cart in Hokkaido. There is plenty of horse power in the northern Island.

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SOME ECONOMIC PHASES OF RICE PRODUCTION IN SOME TOWNS OF LAGUNA¹

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INTRODUCTION

The problem

The Philippine rice farmer has some problems quite the opposite of those other crop producers meet. He produces rice, the main bulk of the food of the Filipino people, and yet oftentimes is himself short of rice in certain months of the year. This incredible situation is the result of certain socio-economic causes some of which are here given. The rice farmer has no source of permanent income except his small rice farm. Hence, only by the sale of his rice product can he get money to buy necessary supplies for his family. Usually, circumstances are such that the crop is sold long before it is harvested, or immediately after harvest. As he sells at a time when rice is abundant the price is low. Also, being in dire need of money he is at the mercy of the rice buyer or middleman. Having sold the greater part of his crop the farmer later in the year has to buy rice for food when the cereal is scarce and the price higher than when he sold. Having no money he is forced to borrow rice from a capitalist, a middleman or, oftentimes, from his landlord, at a very high rate of interest, or to buy at an exorbitant price. To quote Aurelio (1915): "in many cases they are forced to pawn their crop by promising to pay with rice at a price far less than the previous. For example, a farmer borrows ₱10 by pledging his crop at ₱1 a cavan. After the harvest he pays his creditor 10 cavans though rice at the time is ₱3 or more a cavan".

The rice farmer is always at the mercy of an unscrupulous middleman or a crafty landlord. He has no chance for improving his economic condition, and in most cases he is buried in debt and bound to be a tenant for life.

Such economic questions need serious consideration. They cannot be answered by experimentation nor by scientific culture methods. They may be solved only by gradual social reforms, but practically no effort is being exerted in this direction or to raise the standard of living of our peasant farmers who form the bulk of the Philippine population.

¹ Experiment Station contribution No. 460. Received for publication June 27, 1927.

Review of past literature

Much has been written about the social and economic conditions of the Philippine rice farmer. Each writer has noted discouraging financial conditions, yet there seems to be no hope for the farmer to better his status unless help comes from the outside.

"Philippine tenancy," according to Hester (1923), "is heavily weighted with debt. Tenants accept, indeed require advances which are granted by the landlord at rates of interest which appear exceptionally high unless the low security is taken into consideration." He further states that "after the tenant has paid interest on former debts out of his share of the harvest he seldom has enough rice left to his share to last him until the following harvest. In addition, the tenant not infrequently sells a part of his share and throws himself and his family upon the landlord's mercy. . . . The landlord has no alternative but to offset the almost total absence of security with a usurious rate of interest."

Several investigations on tenancy in certain parts of the Philippines have been carried on and have shown that debt is very common among tenants.

Teruel (1923) reports in his investigation of tenancy in Bay, Laguna, "P900.00 of consumptive loans from landlords, P2097.50 of productive loans from landlords; a total of P2997.50, or an average of P18.734 for each of the 160 tenants and P8.907 per hectare of the survey.

"Most of the loans were in the form of palay and were to be paid in palay at about 25 centavos less per cavan than the price at time of loan."

"Of the 81 tenants in Sta. Rosa, Laguna," surveyed by Laserna (1922), "33 had taken no loans whatsoever. There were 41 consumptive loans which ranged in amount from P8.00, the smallest, to P500.00, the largest, the length of time varying from 2 months to 19 months. The total consumptive loans amounted to P7939.88, an average of 98.02 for each tenant."

Of the 151 tenants studied in Naic, Cavite, by Rodis (1922), "78 had advances from their landlords of palay or money, both to be repaid in palay at the end of from one to six months at rates varying from 35 to 290 per cent per annum. Reducing the palay loans to their market-based money value the total amount of the loans of the tenants was P405.60.

"For the survey there were 128 tenants who had contracted third party loans to the principal amount of P1062.40. The average encumbrance for each of the 151 tenants was therefore P8.30, and for each of the 151 tenants surveyed, P7.04, and for each of the 343,389 hectares of the survey, P3.09."

Miller (1920) quotes from an unpublished report of Percy A. Hill on, "Circle for the Study of Social and Economic Conditions in the Philippines." "The crop once planted, the ration of palay is usually discontinued; but the family has to exist, and so a new schedule is put into force, that of *terkian* 50% increase or *takipan* 100% increase, so that if a tenant receives

five cavans between planting and harvest he must pay back seven and a half cavans if *terkiaan*, or 10 cavans if *takipan*. Generally all he has left is an increased debt and the four per cent received by the women for winnowing; however he manages to exist until cropping commences again, when he resumes his ration and debt."

Objects of the present work

The survey here discussed was only preliminary and was on a small scale. The objects were few, but of quite different nature. The points taken are those that were not touched upon or only slightly by previous investigators on similar subjects. The following were the objects of the investigation: (a) To determine the actual earnings of a labor-trader, that is a farm laborer who exchanges work for product rather than for cash wages. The labor-traders herein considered are only the rice threshers and the harvester. (b) To ascertain the real causes for farmers selling their rice immediately after harvest. (c) To determine the probable loss incurred by the farmer when he disposes of his palay immediately after harvest instead of storing it for sale, later.

Time and scope of the survey

The survey was made during March, 1927, in the towns of Los Baños, Cabuyao, Sta. Rosa, and Biñang, all in the province of Laguna.

METHOD OF THE SURVEY

The survey was performed under the direction of Professor Charles F. Baker, Dean of the College of Agriculture, and Professor Inocencio Elayda, Director of Extension Service of the same college. The writer was given two sets of simple questionnaires. A house to house survey was made in the barrios of the towns included in the survey. In the case of the threshers, they were interviewed right in the field while the rice was being threshed. Timing and observation were made during the progress of the work. Besides the given questionnaires other questions bearing on the economic condition of the farmer were asked. Since the questions were short and simple it did not take long to interview one person.

RESULTS OF THE SURVEY

Number of people interviewed

In the whole survey a total of 227 people were interviewed. They were distributed by towns as follows.

Los Baños.....	62
Cabuyao.....	60
Sta. Rosa.....	35
Biñang.....	70
Total.....	227

Of these, 125 were threshers, 102 both harvesters and threshers, and 80, peasant farmers who were also threshers and harvesters.

Methods of sharing the harvest

Two ways of giving shares to the harvesters were found. The first, which is practiced in Los Baños, has this agreement: the harvesters harvest the rice by hand, using a kind of knife made especially for the purpose. Each one threshes his own harvest. After he has threshed and cleaned his own harvest the harvester hands it to the owner and the division is made. The harvester gets one-fifth of the palay he harvests. The second way which is practiced in Cabuyao, Biñang, and Sta. Rosa has this arrangement: the harvesters harvest the rice in the same way as in Los Baños. After the harvest the unthreshed palay is divided at once between the owner and the harvester, the harvester getting one-tenth of the rice as his share. The owner's share is piled together and put in a stack; later, it is threshed by another group of men. Threshing takes place usually from the middle of February to the end of March, and is done by beating the grain with a bamboo flail especially made for the purpose. The threshers are usually organized in teams, of from five to twenty people (men and women). A team receives five cavans for every 100 cavans threshed. This means a share of 4.7 per cent of the total amount they thresh. The share of five cavans is divided equally among the members of the team.

Earnings of the threshers

The data obtained on threshing may be considered accurate because they were obtained in the field during the actual operation. Ten groups of threshers were observed during the course of the investigation. The accompanying table shows data on actual earnings of the thresher.

TABLE 1
Showing earnings of a thresher

TEAM NO.	NUMBER OF MEN ENGAGED	NUMBER OF HOURS WORK	NUMBER OF CAVANS THRESHED	AVERAGE SHARE OF EACH LABORER IN CAVANS PER HOUR
1	23	8	125	.0318
2	17	8	120	.0412
3	15	9	120	.0415
4	13	7	90	.0464
5	4	14	30	.0251
6	11	11	100	.0388
7	7	10	50	.0335
8	15	9	80	.0268
9	10	7	65	.0436
10	10	7	55	.0369
Average				.03656

Column five was obtained by multiplying the number of cavans threshed by all the men by 4.7 per cent which is the usual rate given as share, dividing the result by the number of men, and then by the number of hours spent in threshing.

The earnings of a man an hour in terms of money depend upon the price of palay at the time. If the price of palay is ₱3.00, ₱3.50, ₱4.00, and ₱5.00, then the earnings of a man an hour by threshing will be ₱0.1095, ₱0.12775, ₱0.146 and ₱0.1825.

The harvester

The harvesters considered are those from Cabuyao, Biñang, and Sta. Rosa. These harvesters get one-tenth of the unthreshed rice as their share for harvesting. From records obtained from about one hundred of these harvesters the writer computed the earnings of each harvester an hour to be an average of 1.172 gantas or .047 cavans. Reduced to money values the harvester can earn at least ₱.141 per hour.

Earnings of the Los Baños labor-trader

As the Los Baños share system differs from that of the other three towns investigated, the earnings of the Los Baños labor-trader would not be the same as in these towns. From reports of 62 persons in Los Baños the writer found that an average of 2.1 gantas or .084 cavans was the share of each laborer per hour of work. The work is a combination of harvesting, threshing, and cleaning, all done on the same day. Reducing the earnings to money values it is evident that if the price of palay is ₱3.00, which is the lowest price, the laborer will earn ₱0.252 per hour. So the Los Baños labor trader can earn at least ₱0.25 per hour.

Comparison of shares between the two systems

In the one-fifth share contract, the share of the laborer is .084 per hour. Adding .03656 cavans and .047 cavans the shares of two sets of laborers in the two contracts we have .08350 cavans, the sum of the shares of the two laborers for one hour work in the Cabuyao, Sta. Rosa, Biñang system. Therefore, there is a difference of .00044 cavans in favor of the Los Baños system. The other share is a product of two hours labor by one

laborer. Apparently, the Los Baños system is more advantageous to the laborer, but not to the landowner.

TABLE 2

Showing the relation of the price of palay to the farmer's farm operation

MONTH	FARMER'S WORK	CONDITION OF RICE SUPPLY	PRICES OF RICE AND PALAY	FARMER'S CONDITION
December	Harvesting lowland rice	Rice abundant in lowlands. Farmer's selling season, supply plentiful, prices comparatively low.	<i>Clean rice</i> From ₱.25 to ₱.35 a ganta or from ₱6.25 to ₱8.75 a cavan.	Farmer sells rice. Season of entertainments and fiestas, etc.
January			<i>Palay</i> From ₱3 to ₱4 a cavan. Av. report ₱3.63 a cavan.	
February	No farm work			
March	Threshing rice			
April	No farm work			
May	Preparation of land	Rice scarce. Prices high, most farmers supply low.	<i>Clean rice</i> From ₱.40 to ₱.50 a ganta.	Most farmers short of rice. Season of buying, pawning, or borrowing.
June			<i>Palay</i> From ₱4 to ₱6 a cavan. Av. ₱4.82	
July	Planting season in lowlands			
August				
September	Caring for growing rice	Fair supply because of harvest from uplands. Prices medium.	<i>Clean rice</i> From ₱.35 to ₱.40 a ganta.	Farmer subsists on upland rice.
October			<i>Palay</i> From ₱3 to ₱3.50 a cavan.	
November				

As may be seen from table 2 the farmer sells palay at an average price of ₱3.63 a cavan and buys at an average price of ₱4.82. Thus by selling his rice immediately after harvest during the season of plenty instead of holding it until the time of scarcity he loses 35.5 per cent. For example, a farmer who produces 200 cavans of rice will get only ₱726 if he sells immediately after harvest at ₱3.63, whereas if he waits till the time of scarcity he can sell at ₱4.82 and get ₱964 for his 200 cavans. Even granting that the ₱726 earns interest, say 10 per cent, for five months there would still be the difference of ₱207.75 in favor of the returns in time of scarcity. This condition will not change even if all the farmers hold their rice. The market for rice is very wide and during the months of May to August, the time in which rice is scarce in most parts of the Philippines, the price of rice is always high. In this event what actually will happen is that the rice will change hands, and, possibly, middlemen will be eliminated. Instead

of the middlemen holding the rice, the farmers themselves will. The figures obtained appear rather conservative because the rice advanced by middlemen at usurious rate of interest is not included. The item "advanced rice" was not included in this investigation as it was well covered by previous investigators.

Availability of secondary occupation in the region surveyed

While conducting the survey the writer was interested to find that the after-harvest selling of rice did not prevail among Los Baños farmers. No matter how hard up the Los Baños farmer may be, he does not sell his rice right after harvest unless he has an over-supply. The Los Baños farmer or labor-trader can hold his rice because there is always available labor in the vicinity. The College of Agriculture, the quarry under the Bureau of Public Works, and occasionally Camp Eldridge, the United States Army Post, all located in the municipality, are the sources of employment. Another reason is that rice growing is only a minor industry in Los Baños, only enough is produced for home consumption. In the other towns surveyed, farming is the primary occupation of the farmers. Except such minor secondary occupations as driving cart or carromata or some road work, work in these towns is very uncertain, hence, there being no other way to get cash, the rice is sold as soon as it is threshed.

DISCUSSION OF RESULTS

Two systems of giving shares to the labor-trader was found and the actual share of each per hour was determined. Under the Los Baños system a laborer gets .084 cavan per hour, while in the Cabuyao, Sta. Rosa, Biñang system he gets .047 cavan per hour for harvesting and .03656 cavan per hour for threshing. Only men and women are considered in this investigation. Children are found to be of little use in these operations. Men and women are rated equally because it is said that on the average their ability in this kind of work is practically the same.

The data presented covering the share of a labor-trader are based on the hour because it would be very misleading if based on the day. The number of working hours of laborers vary from two to ten hours a day, consequently, earnings a day are variable.

From the results it may be seen that the hourly earnings of a labor-trader are fairly high. Ten centavos an hour on the farm is comparatively good wages in the Philippines, the drawback is that laborers cannot work for many consecutive hours. For example, many harvesters work in one field, with the result that after three or four hours the work is finished and the laborer's daily wage as a thresher or a harvester is low. As a matter of fact, the labor-trader is very lucky if he works on the average of four hours a day during harvest time, especially in places like Los Baños where the rice fields are not very large. In the other three towns surveyed where

most of the farm is planted to rice, the labor-trader has longer work days than in Los Baños. This explains why the laborers are content though their wage per hour is lower than that of the Los Baños labor-trader.

As there is much jollity at harvest and threshing time, the labor-trader considers the work a species of fiesta as well as a mode of earning wages. It is always inspiring for the young men to have fair damsels working with them. One might say that harvesting and threshing time is a sort of social season for the rice farmers. Sometimes, to make the harvesting a lively affair, young women are especially invited.

Table 2 shows the relation of the rice supply to the price of rice. It was found that during and after harvest the price of palay is comparatively low. The average price of palay during harvest is ₱3.63 a cavan, while in time of scarcity it rises as high as ₱6.00 a cavan, the average being about ₱4.82. The farmer loses about 35.5 per cent of the money he would have received had he been able to wait for the time of scarcity.

It was found that in Cabuyao, Sta. Rosa, and Biñang, most farmers are compelled to sell their rice immediately after threshing. They are always in need of money for household needs, as they have no source of permanent income. If a farmer has a permanent secondary occupation he may hold his rice. This is the case with the Los Baños farmers, who are the best-off among the towns surveyed. This comparatively well-to-do condition of the Los Baños farmer is explained by the fact that when they are through with their farm labor, they can earn at least one peso a day as a common laborer. Hence, Los Baños farmers do not sell their rice unless they have a surplus, because they can always earn ready money by other work than farming. In the other three towns there are a few home industries and secondary occupations, but returns are very uncertain.

There are other major causes for farmers and farm laborers disposing of their rice immediately after harvest. There are many farmers whose production is enough for their family subsistence, but they are in debt. The Filipino farmer has one fundamental defect—lack of foresight. He does not plan for incidental expenses. Once such expenses occur, since he has no savings, he has to borrow money or pawn his crop. On this, Hester (1923) says: "Consumptive loans are made generally in cash granted by the landlord to the tenant for the purpose of supplying the outlay for a tenant marriage, baptism or funeral, ceremonies which in the Philippines involve the spreading of feast and expenditures of time and money out of proportion to all other points in the standard of living. Not infrequently a funeral will cost the tenant's family in money and food a sum equal to one-half of their annual income." Once this debt is incurred it is paid in palay at a fixed price, with the result that they never get the full money value for their crops.

Since the most apparent cause responsible for the present financial condition of the rice farmer is that he is jobless so much of the time (cer-

tainly in Los Baños where this condition does not obtain, the farmer is better off), the obvious remedy is to make conditions such that the farmers are busy throughout the year. One possible way to do this is induce the farmer to practice diversified farming. At present he is following the one crop system "abandoned in China, Japan, and Europe centuries ago." In the towns surveyed, diversification cannot be practised unless irrigation systems are constructed, because after the rice is harvested no crop will grow because the soil is too dry.

If irrigation systems cannot be constructed the other possibility is to develop many home industries so as to provide work for laborers during the dry season. The blame for the deplorable condition of indebtedness of the farmers cannot be wholly laid on them, because frequently circumstances force them to be idle. Jobs are not available and they cannot till the soil in the dry season, but they and their families have to eat, so if they have not produced enough for subsistence they have to go in debt.

SUMMARY

Since this survey was very limited in scope and preliminary in plan no broad and definite conclusions can be drawn. Only a summary is here given.

1. Two types of sharing the harvest were found in the area surveyed. The Los Baños type in which the labor-trader is the harvester and the thresher at the same time and gets one-fifth of the harvest as share, and the Cabuyao, Sta. Rosa, and Biñang type in which harvesting and threshing are done by separate groups of people, the harvester getting one-tenth as share and the thresher, 4.7 per cent.

2. The labor-trader in Los Baños earns .084 cavan per hour as share while the labor-trader in Cabuyao, Sta. Rosa, and Biñang earns .047 cavan by harvesting and .03656 by threshing. Reduced to money values, the Los Baños labor-trader earns about 25 centavos an hour and the other labor-traders about 10 centavos an hour.

3. The farmers sell their rice during harvest or threshing season at an average of ₱3.63 per cavan. They cannot afford to wait for better prices because there are always urgent necessities to provide or debts to pay. They have no permanent income except their rice product, so that as soon as the rice is harvested, it must be sold.

4. The farmer that gets short of rice pays an average of ₱4.82 per cavan for palay or ₱.45 a ganta for cleaned rice. The shortage usually occurs during the months of June, July, and August, the season when the farmers are busy preparing their land for planting.

5. The farmer loses about 35.5 per cent by selling his rice right after harvest and not waiting for the later higher prices in time of scarcity.

6. The farmers of Los Baños do not sell rice unless there is an over-supply because they are not in such need of money because of opportunity to earn as laborers in other lines of work.

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NON-GAS ELECTRODES FOR pH DETERMINATIONS¹

AMADO J. DE LA CRUZ

INTRODUCTION

There are two general methods employed in the industrial determination of the hydrogen-ion concentration. The colorimetric method depends upon the changes in color that certain substances undergo when in presence of different concentrations of hydrogen. The electrometric method depends upon the fact that some metals, when used alone or in conjunction with other substances, set up definite and reproducible electrical potentials when placed in contact with definite hydrogen-ion concentration.

Each method has its advantages and disadvantages. On the one hand, in any determination where colors are to be compared with the unaided eye, errors due to the personal equation are great. Furthermore, these colors are affected by the presence of proteins or certain salts, and are not easily reproducible either on paper or in solution, owing to the effect of light and moisture. The great point in favor of the colorimetric method, however, is the ease with which a determination may be made and the minimum training necessary on the part of the observer.

With the electrical method, one great drawback is the amount of necessary technique that an observer should possess, before good results may be obtained. This is somewhat offset by the fact that personal errors are much fewer than with the color method. Another great disadvantage of the electrical method is that the electrodes are susceptible to certain specific "poisons" which completely nullify the value of the potential measurements. In the case of gas electrodes like the hydrogen electrode, where a metal is made a very good absorbent of the gas, the susceptibility to poisons becomes much greater.

In order to obviate this difficulty and the difficulty of preparing pure gases for gas electrodes, non-gas electrodes have been introduced.

Review of the literature

The first researches along the line of non-gas electrodes were made on the quinhydrone electrode by Büllmann (1921) and by Büllmann and Lund (1921). Later, Büllmann (1924) and Baver (1926) made use of this electrode

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in determining the pH of soils, while Harris (1923) studied its use in the analyses of mixtures of amino acids, and La Mer and Parsons (1923) studied its application to electrometric acid-base titrations in the presence of air. Farnell (1925) indicated its use in sugar work, giving a sketch of his apparatus, but he did not give any data on the difference of readings between the quinhydrone electrode and the hydrogen electrode at different pH values. He pointed out that while its use is much less cumbersome than the hydrogen electrode, it has the disadvantage of giving unreliable results above pH 8, (a finding also obtained by La Mer and Parsons) and it is entirely useless when used in presence of strong reducing agents, as sulfites. Later, Dawson (1926) devised a liquid-flowing junction in connection with the quinhydrone electrode for determining the pH of sugars, but he also found that this electrode could not be used reliably at a pH higher than 8.5.

Bayliss (1923), using tungsten electrodes, succeeded fairly well in measuring the hydrogen-ion concentration for potable water, and Balch and Paine (1925) have found the use of this electrode for sugar work rather efficient. Parker (1925), in studying different electrode combinations, succeeded in obtaining a few promising ones, but he did not test their uses in industrial solutions.

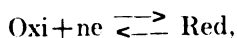
At the present time, no electrode combination has yet been found which possesses the advantages of being useful for a wide range of pH, of non-susceptibility to poisons, and of giving the true potential reading in a short time.

In order to understand fully the results, a discussion of the non-gas electrode is necessary.

Theory of non-gas electrodes

If the ordinary assumption is made that an oxidation-reduction reaction is a process of an exchange of electrons, it may also be further assumed, as was pointed out by Langmuir (1916), that the free electrons which have just detached themselves from either the oxidized or the reduced ions, set up a "pressure" of free electrons. At equilibrium, these electrons would set up a steady characteristic electron pressure or concentration.

In general, an oxidation-reduction reaction may be represented by the equation:



Where Oxi = oxidant

Red = reductant

e = electron

n = number of electrons necessary per molecule of the oxidant.

Applying the law of Mass Action

$$\frac{(\text{Oxi}) (e)^n}{(\text{Red})} = K, \text{ so that}$$

$$(e) = \sqrt[n]{K \frac{(\text{Red})}{(\text{Oxi})}} \quad (1)$$

If the presence of free electrons in metals is assumed, as is ordinarily done, and activity a_m , ascribed to these electrons, and activity a_s to the electrons in the solution phase, then the change ΔF in free energy accompanying the isothermal transfer of one Faraday of electrons from one phase to the other is

$$\Delta F = RT \ln \frac{a_m}{a_s} \quad (2a)$$

Here R and T have their usual significance.

If the potential difference between metal and solution is E , and F is the Faraday, then $F \times E = \Delta F$, and

$$E = \frac{RT}{F} \ln a_m - \frac{RT}{F} \ln a_s \quad (2b)$$

In dilute solutions, where activity and concentration are very nearly equal to each other, equation (2b) may be written as

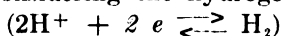
$$E = \frac{RT}{F} \ln (e)_m - \frac{RT}{F} \ln (e)_s \quad (3)$$

Substituting the value of (e) in equation (1) and $(e)_s$ in equation (3),

$$E = \frac{RT}{F} \ln (e)_m - \frac{RT}{nF} \ln K \frac{(Red)}{(Oxi)} \quad (4a)$$

This is the single electrode potential due to an oxidation-reduction reaction.

Considering the hydrogen electrode, since



$$\text{hence, } \frac{(H^+)^2 (e)^2}{(H_2)} = K'_H$$

Instead of (H_2) , $K'_H P_{H_2}$ may be written where P_{H_2} is the partial pressure of gaseous hydrogen.

$$\text{Hence, } \frac{(H^+)^2 (e)^2}{P_{H_2}} = K'_H \cdot K', \text{ or}$$

$$(e) = \sqrt{K_{H(H^+)^2} \frac{P_{H_2}}{K'_H}} \text{ where } K_H = K'_H \cdot K' \quad (5)$$

Substituting (e) in equation (3) for $(e)_s$ in equation (3),

$$E = \frac{RT}{F} \ln (e)_m - \frac{RT}{F} \ln \sqrt{K_H} \frac{\sqrt{P_{H_2}}}{(H^+)}, \text{ or}$$

$$E = \frac{RT}{F} \ln (e)_m - \frac{RT}{F} \ln \sqrt{K_H} - \frac{RT}{F} \ln \frac{\sqrt{P_{H_2}}}{(H^+)} \quad (6a)$$

This is the electrode potential at the hydrogen electrode.

For a metal electrode in contact with a solution containing metallic ions of the electrode, from equation (4a) follows

$$E = \frac{RT}{F} \ln (e)_m - \frac{RT}{nF} \ln K \frac{(M)_s}{(M^{n+})}$$

where $(M)_s$ = concentration of the metal in solution in equilibrium with the electrode, and (M^{n+}) = concentration of the metallic ions in solution.

Since the concentration of the metal in solution is supposedly in equilibrium with the undissociated metal, that is, $(M)_s = K''_1(M)_m$, the above equation may be written thus:

$$E = \frac{RT}{F} \ln (e)_m - \frac{RT}{nF} \ln K K''_1(M)_m - \frac{RT}{nF} \ln \frac{1}{(M^{n+})} \quad (7a)$$

Gathering the constants in each of the equations (4a), (6a), and (7a), there is:

For the potential at the oxidation-reduction electrode:

$$E = E_1 - \frac{RT}{nF} \ln \frac{(Red)}{(Oxi)} \quad (4b)$$

For the potential at the hydrogen electrode:

$$E = E_2 - \frac{RT}{F} \ln \frac{\sqrt{P_{H_2}}}{(H^+)} \quad (6b)$$

For the potential of the metal electrode in contact with its metallic ions:

$$E = E_3 + \frac{RT}{nF} \ln (M^{n+}) \quad (7b)$$

From these equations, it is evident that a given electrode may be regarded either as an oxidation-reduction electrode, hydrogen electrode, or a metal electrode in contact with its metallic ions.

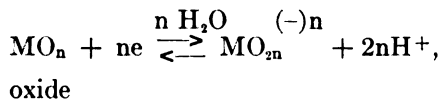
However, if the electrode is to be used either as a hydrogen (or an oxygen) electrode, in order that the true value for E may be determined, there must be, around the electrode, a definite or finite pressure of either the hydrogen or oxygen gas.

To avoid the necessity of creating definite pressures of either H_2 or O_2 for their respective electrodes, the more plausible method would be to utilize the oxidation-reduction electrode where the E does not require definite H_2 or O_2 pressures.

To consider a general example of the oxidation-reaction potential:

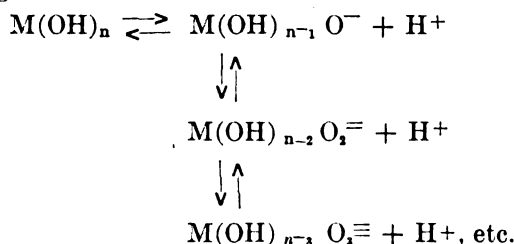
Take an oxide and assume that the solution contains a reducing electrolyte of the type HB where H denotes the replaceable hydrogen and B denotes the anion ($HB \rightleftharpoons H^+ + B^-$).

The reduction of the oxide may be represented thus:



(Here M is the metal)

or the dissociation of the hydroxide may be represented according to the following:



The mass action equations of the above reactions may be written as:

$$k_1 = \frac{[M(OH)_{n-1} O^-] [H^+]}{[M(OH)_n]} \quad (a)$$

$$k_2 = \frac{[M(OH)_{n-2} O_2^{=}] [H^+]}{[M(OH)_{n-1} O^-]} \quad (b)$$

$$k_3 = \frac{[M(OH)_{n-3} O_3^{\equiv}] [H^+]}{[M(OH)_{n-2} O_2^{=}] } \quad (c)$$

and

$$\begin{aligned} [M(OH)_n]_{total} &= [M(OH)_n] + [M(OH)_{n-1} O^-] \\ &\quad + [M(OH)_{n-2} O_2^{=}] + [M(OH)_{n-3} O_3^{\equiv}] \end{aligned} \quad (z)$$

If the reduction takes place in only one stage and if the degree of dissociation is very small, then from equations (a) and (z), the value of

$\frac{[Red]}{[Oxi]}$ may be written thus:

$$\frac{[Red]}{[Oxi]} = \frac{[M(OH)_{n-1} O^-]}{[MO_n]} \cdot \frac{k_1 [M(OH)_n]_{total}}{[H^+] [MO_n]}$$

so that from equation (4b), the following equation may be written:

$$E = E_1 - \frac{R T}{F} \ln \frac{k_1 [M(OH)_n]_{total}}{[H^+] [MO_n]}$$

$$= E_1 - \frac{R T}{F} \ln k_1 - \frac{R T}{F} \ln \frac{[M(OH)_n]_{total}}{[MO_n]} + \frac{R T}{F} \ln [H^+]$$

or

$$E = E'_1 - \frac{R T}{F} \ln \frac{[M(OH)_n]_{total}}{[MO_n]} + \frac{R T}{F} \ln [H^+] \quad (8a)$$

Under rather alkaline conditions, when the concentrations of both the oxide and the hydroxide may be considered constant, equation (8a) may be written,

$$E = E''_1 + \frac{R T}{F} \ln [H^+] \quad (8b)$$

If the dissociation of the hydroxide takes place in two stages, then from equations (a), (b), and (z),

$$[M(OH)_{n-2} O_2^{2-}] = \frac{k_1 k_2 [M(OH)_n]_{total}}{[H^+]^2 + k_1 [H^+] + k_1 k_2}, \text{ so that}$$

equation (4b) may be written as

$$E = E_1 - \frac{R T}{2 F} \ln \frac{k_1 k_2 [M(OH)_n]_{total}}{[MO_n] [(H^+)^2 + k_1 (H^+) + k_1 k_2]}$$

$$= E_1 - \frac{R T}{2 F} \ln k_1 k_2 - \frac{R T}{2 F} \ln \frac{[M(OH)_n]_{total}}{[MO_n]} +$$

$$\frac{R T}{2 F} \ln [(H^+)^2 + k_1 (H^+) + k_1 k_2]$$

Again, under certain alkaline conditions, and collecting terms,

$$E = E_1''' + \frac{R T}{2 F} \ln [(H^+)^2 + k_1 (H^+) + k_1 k_2] \quad (9a)$$

Furthermore, if the values of k_1 and k_2 are small in comparison with the value of (H^+) , as in the case of the quinhydrone electrode. ($k_1 = 1.75 \times 10^{-10}$ and $k_2 = 4 \times 10^{-12}$), equation (9a) may be further reduced thus:

$$E = E_1''' + \frac{R T}{F} \ln [H^+] \quad (9b)$$

which is similar to equation (8b).

If, however, the values of k_1 and k_2 are very large in comparison with (H^+) , then it is evident that

$$E = E_1''' + \frac{RT}{2F} \ln (k_1 k_2), \text{ or}$$

$$E = \text{constant.} \quad (9c)$$

that is, the value of the observed e.m.f. of the electrode is constant.

Between these two extremes, of course, lie values of (H^+) , k_1 and k_2 which are more or less comparable.

Equation (6b) may be written

$$E_H = E_2 - \frac{RT}{F} \ln \sqrt{P_{H_2}} + \frac{RT}{F} \ln (H^+) \quad (6c)$$

If, therefore, a hydrogen electrode be set up against an oxidation-reduction electrode, from (8b) or (9b) and (6c),

$$E_{o-r} - E_H = E_1'' - E_2 + \frac{RT}{F} \ln \sqrt{P_{H_2}} \quad (10)$$

So that it may be said that the resultant potential is independent of the hydrogen ion concentration of the solution.

Object of the present work

The purposes of the present investigation were to find suitable non-gas electrodes, which would be ideal for the determination of the hydrogen-ion concentration of some solutions. It was the purpose, especially, to find electrodes that may be used in determining the hydrogen-ion concentration of sugar cane juice, and to offer suggestions for further investigation on the subject in its application to factory scale processes.

Time and place of the present work

The experiments were conducted in the Department of Agricultural Chemistry, College of Agriculture, from April 20, 1926, to February 12, 1927, a period of about ten months.

MATERIALS AND METHODS

Buffer solutions and other chemicals

Throughout the investigation the water that was used for the buffer solutions was distilled three times in glass condensers, and kept in non-sol bottles. In the preparation of the buffer solutions the chemicals used were fractionally crystallized four times from the C. P. chemicals and thoroughly dried in an electric oven at 110°C . For the method used in preparing these buffer solutions, that given by Clark (1922, p. 107) was followed.

In the preparation of the calomel electrode the KCl used was fractionally crystallized four times from C. P. KCl. The mercury used was purified according to Clark (1922).

The quinhydrone used was prepared by the Division of Soils and Fertilizers of the Bureau of Science, Manila. No attempt was made to purify this compound.

For the solutions to be investigated, sugar juices were daily obtained from the field and clarified with lime or NaOH. In some cases the juice was allowed to stand for one or more days, during which time the protein matter settled. In other cases, the clarified juice was treated with acid to lower the value of its pH.

In the preparation of the HCl and NaOH solutions, the ordinary analytical methods were followed.

The potentiometer

For the measurement of the electrode potential, the type K potentiometer of Leeds & Northrup was employed. In conjunction with this apparatus a portable galvanometer of Leeds & Northrup, a Weston standard cell Model 4, and a 2-volt storage battery were used.

Non-gas electrodes

In the search for the best electrode combinations that satisfy the requirements of an ideal electrode the following combinations of non-gas electrodes were studied:

Quinhydrone electrode

Cu No. 24, BaO₂
 Cu No. 28, BaO₂
 Cu No. 24, H₂O₃
 Cu No. 28, Al₂O₃
 Cu No. 30, Al₂O₃
 Cu No. 24, PbO₂
 Cu No. 28, PbO₂
 Cu No. 30, PbO₂
 Cu No. 24, Fe₂O₃
 Cu No. 28, Fe₂O₃
 Cu No. 30, Fe₂O₃
 Cu No. 24, CuO (red)
 Cu No. 28, CuO (red)
 Cu No. 30, CuO (red)
 Cu No. 24, CuO (black)
 Cu No. 28, CuO (black)
 Cu No. 30, CuO (black)
 Al, BaO₂
 Al, Al₂O₃
 Al, PbO₂
 Al, Fe₂O₃
 Al, CuO (red)
 Al, CuO (black)

The wires and the oxides used for these electrodes were obtained, as "Baker's Analyzed Chemicals," from J. T. Baker Chemical Co.

After many trials, it was found that, besides the quinhydrone electrode, the electrode which gave the most easily reproducible potential was the Al,

BaO₂ combination. To prepare this electrode, a No. 14 aluminum wire was thoroughly cleaned by rubbing it with alcohol and ether and then made into a coil about five centimeters long. An aqueous solution of C. P. BaCl₂ was then prepared and a few drops of this mixed with C. P. Baker's Analyzed acetone. Two aluminum coils were dipped in this solution and these coils were then electrolyzed by changing the electrode poles alternately positive and negative every five minutes for about two hours. When dried in an electric oven, the electrodes, originally metallic, became coated with a thin adherent white coating of BaO₂.

In order that reproducible electrode potentials could be obtained, it was found necessary to continuously stir the solution under investigation. For this purpose, an electric motor in conjunction with a glass stirrer was employed.

In preparing the quinhydrone electrode, the method of Baver (1926) was followed with slight modifications. The solution under investigation was placed in a 50 cc. beaker and a pinch of quinhydrone (about 0.05 gram) added to it. Then a platinum electrode about one centimeter square, sealed to a glass tube filled with mercury, was dipped in the solution. Readings of the potentiometer were made exactly one minute after the addition of the quinhydrone to the solution. To keep the surface of the platinum bright, it was cleaned with chromic acid solution after every twenty readings. To prevent diffusion from the solution to the KCl solution of the calomel electrode, a small bridge filled with agar dissolved in KCl solution of the same strength as that of the calomel electrode was used.

No control of the temperature was made; the room had a temperature of from 25° to 28°C. Nor were barometric corrections made, as the error due to these are, for the purpose of this study, small.

EXPERIMENTS AND RESULTS

Table 1 gives the e.m.f. of the system Al, BaO₂—HA—calomel, containing the buffers HA of different hydrogen-ion concentrations. Four different aluminum electrodes were used; these were first dried at 60°C. for 10 minutes before immersion in the solutions.

TABLE 1

e. m. f. of the cell Al, BaO₂—HA—normal calomel electrode containing different buffer solutions

	E ₁	E ₂	E ₃	E ₄	E average
<i>pH of buffer</i>	<i>volts</i>	<i>volts</i>	<i>volts</i>	<i>volts</i>	<i>volts</i>
10.01	1.463	1.463	1.464	1.466	1.464
9.38	1.262	1.262	1.267	1.263	1.263
9.00	1.138	1.142	1.148	1.152	1.145
8.47	0.990	0.998	0.998	0.990	0.991
8.07	0.884	0.892	0.886	0.885	0.887
7.00	0.571	0.567	0.577	0.584	0.575
6.05	0.499	0.491	0.497	0.494	0.495

The pH of the buffer solutions were determined separately by means of the hydrogen electrode.

The time necessary for obtaining a constant potential was rather long, and it was thought that if instead of drying in the oven, the electrodes were soaked in distilled water preparatory to immersion in the buffer solution, the equilibrium time would be reduced. Table 2 gives the average equilibrium time for the electrodes when dried in the oven and when soaked in water for five minutes.

TABLE 2
Comparison of equilibrium time for dried and wet electrodes

pH	AVERAGE EQUILIBRIUM TIME STARTING WITH DRIED ELECTRODES	AVERAGE EQUILIBRIUM TIME STARTING WITH WET ELECTRODES
	min.	min.
10.0	50	50
9.5	90	55
9.0	80	65
8.5	90	100
8.1	65	95
7.0	50	55
6.1	40	45

Table 3 gives the average values of the e.m.f. of the system $\text{Al, BaO}_2\text{—HA—H}_2\text{Pt}$ when the HA of the buffer solutions has different pH. The hydrogen electrode is here considered positive.

TABLE 3
e. m. f. of the system $\text{Al, BaO}_2\text{—HA—H}_2\text{Pt}$ containing different buffer solutions

pH	AVERAGE E. M. F. OF THE CELL VOLTS
10.0	+0.574
9.4	+0.423
9.0	+0.141
8.5	+0.214
8.1	-0.013
7.0	-0.161
6.0	-0.263

Table 4 gives the e.m.f. of the system, $\text{Al, BaO}_2\text{—HA—calomel}$, containing the solutions of partially neutralized HCl and NaOH the pH of which has been determined by the hydrogen electrode. Each value of the

pH around the range 7 to 10 is compared with the value calculated from the results of table 1. The equilibrium time for the electrode is also given.

TABLE 4

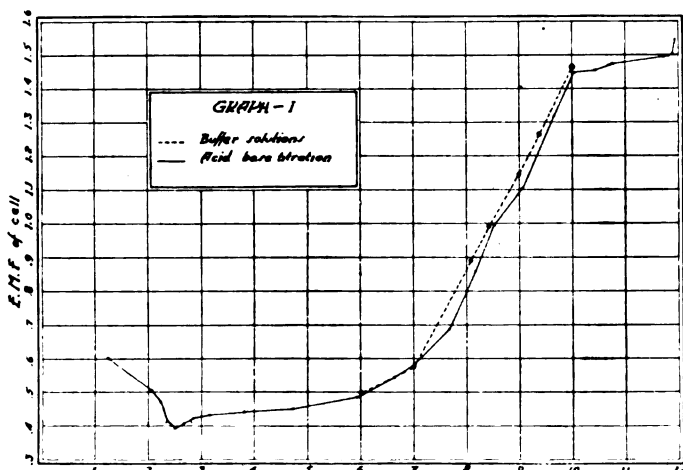
Comparison between the hydrogen and the Al, BaO₂ electrode in acid-base titrations around the range pH 7-10

SOLUTIONS USED	E.M.F. OF THE CELL, Al, BaO ₂ —HA—CALOMEL	pH CALCULATED FROM EQUATION (11)	pH DETERMINED BY THE HYDROGEN ELECTRODE	DIFFERENCE IN THE pH	TIME OF EQUILIBRIUM FOR THE AL—BaO ₂ ELECTRODE
					min.
N/100 HCl	0.506		2.08		20
200 cc. N/100 HCl + 20 cc. N/100 NaOH	0.474		2.22		25
200 " " + 40 " "	0.417		2.35		20
200 " " + 60 " "	0.396		2.49		25
200 " " + 80 " "	0.405		2.65		25
200 " " + 100 " "	0.423		2.85		30
100 " " + 60 " "	0.436		3.15		35
100 " " + 70 " "	0.443		3.80		35
100 " " + 80 " "	0.452		4.72		35
100 " " + 90 " "	0.485	6.81	5.96	0.85	30
100 " " + 95 " "	0.548	7.02	6.63	0.39	35
100 " " + 100 " "	0.584	7.02	7.01	0.01	35
	0.686	7.43	7.67	0.24	30
97 " " + 100 " "	0.860	8.05	8.18	0.13	55
95 " " + 100 " "	0.996	8.50	8.52	0.02	55
90 " " + 100 " "	1.123	8.95	9.06	0.13	45
80 " " + 100 " "	1.320	9.57	9.66	0.09	55
70 " " + 100 " "	1.448	9.99	10.03	0.04	60
60 " " + 100 " "	1.457	10.02	10.43	0.41	45
100 " " + 200 " "	1.472		10.77		60
N/20 HCl	0.610		1.23		25
	1.493		11.73		20
	1.496		11.81		15
	1.505		11.90		15
N/20 NaOH	1.544		11.93		5
	0.488		6.00		25

Table 5 shows the values of the pH obtained by the use of the hydrogen electrode and of the quinhydrone electrode, and the difference between the readings, when solutions of clarified, unclarified, and fermented sugar juices are used.

Graph I shows the relation between the e.m.f. of the system, Al, BaO₂—HA—calomel and the pH of the solution HA. The points indicated by circles are points corresponding to the ordinary acid-base titration between

HCl and NaOH, while the points indicated by squares are points corresponding to the buffer solutions.



DISCUSSION OF RESULTS

For the present, except for the system Al—BaO₂, no attempt was made to follow the study of the different electrode combinations described. Experience has shown that extreme cleanliness is required for the proper workings of the other electrode combinations, a condition which prevents their use in ordinary industrial applications.

Since for sugar cane juices the main interest lies around pH=8.8, the concentration generally considered for the best lime clarification, buffers and other solutions were selected to vary from around pH 6 to around pH 10.

Table 1 shows that the potential of the system using the Al—BaO₂ as an electrode may be easily duplicated. This is true when different Al—BaO₂ electrodes are used in the same solution, or when the same electrode is used many times in different buffer solutions of the same pH.

It was thought that previous immersion of the electrode in some neutral reagent might affect the time of equilibrium. Accordingly, some electrodes were immersed in water for 30 minutes before using, while the others were dried before use. Table 2 shows that there is no appreciable difference in the time of equilibrium for dried and wet electrodes.

If the potential of the normal calomel electrode is taken as +0.565 (at 25° C.), then the potential of the Al—BaO₂ electrode in the different pH solutions may be calculated. In table 6 this will be called E_{obs} . On plotting E_{obs} against the pH, as in graph I, it may be seen that a straight line is obtained from pH 10.0 to around pH 7.0, which may be represented approximately by the equation,

$$E_{calc} = E_o - 5.05 (0.06) pH \quad (11)$$

where $E_o = 2.145$ volts.

TABLE 5
Values of the pH of sugar solutions as determined by the hydrogen and quinhydrone electrodes

HYDROGEN ELEC- TRODE	QUINHY- DRONE ELEC- TRODE	DIF- FERENCE	HYDROGEN ELEC- TRODE	QUINHY- DRONE ELEC- TRODE	DIF- FERENCE	HYDROGEN ELEC- TRODE	QUINHY- DRONE ELEC- TRODE	DIF- FERENCE	HYDROGEN ELEC- TRODE	QUINHY- DRONE ELEC- TRODE	DIF- FERENCE	HYDROGEN ELEC- TRODE	QUINHY- DRONE ELEC- TRODE	DIF- FERENCE
pH	pH	pH	pH	pH	pH	pH	pH	pH	pH	pH	pH	pH	pH	pH
6.27	6.62	0.33	7.91	8.26	0.35	8.49	8.78	0.29	9.28	9.53	0.25	10.71	10.36	-0.31
6.26	6.38	0.12	7.95	8.24	0.29	8.12	8.47	0.35	9.93	10.26	0.32	10.65	10.27	-0.38
6.60	6.76	0.16	7.58	7.76	0.20	8.66	8.88	0.22	9.59	9.88	0.29	10.93	10.40	-0.53
6.07	6.19	0.12	7.25	7.38	0.13	8.98	9.11	0.13	9.71	9.95	0.24	10.81	10.51	-0.30
6.28	6.42	0.14	7.24	7.43	0.19	8.35	8.49	0.13	9.01	9.22	0.20	10.65	10.39	-0.26
6.64	7.78	0.14	7.34	7.50	0.16	8.37	8.45	0.08	9.02	9.29	0.26	10.51	10.18	-0.33
6.74	6.83	0.09	7.38	7.52	0.14	8.85	9.02	0.17	9.16	9.35	0.19	10.88	10.36	-0.52
6.70	6.88	0.18	7.41	7.59	0.18	8.71	8.99	0.28	9.18	9.40	0.22	10.93	10.76	-0.17
6.55	6.67	0.12	7.68	7.77	0.09	8.44	8.56	0.12	9.23	9.48	0.25	10.66	10.54	-0.12
6.39	6.54	0.15	7.57	7.88	0.31	8.69	8.86	0.18	9.31	9.52	0.22	10.71	10.50	-0.21
			7.51	7.82	0.31	8.94	9.20	0.26						
			7.34	7.56	0.22	8.81	9.06	0.25						
			7.38	7.54	0.16									
Average		+0.12			+0.21			+0.20			+0.24			-0.31

From equation (11), knowing the pH of the solution, the value of E_{calc} , can be calculated. Table 6 gives a comparison of E_{obs} , and E_{calc} .

TABLE 6
Comparison of observed and calculated e. m. f. at the Al, BaO₂ electrode

PH	POTENTIAL OF CELL	E_{obs} OF HALF CELL	E_{calc} OF HALF CELL	$E_{obs} - E_{calc}$
10.0	1.464	-0.899	-0.855	-0.014
9.4	1.263	-0.698	-0.703	-0.005
9.0	1.145	-0.580	-0.582	-0.002
8.5	0.991	-0.426	-0.430	-0.004
8.1	0.887	-0.322	-0.309	+0.013
7.0	0.575	-0.010	-0.024	-0.014
6.0	0.495	+0.070	+0.327	-0.257

The last column in table 6 shows that at pH 6, the behavior of the Al—BaO₂ electrode is somewhat different.

Since from either equation (8b) or (9b),

$$E = E_o + 0.06 \log (H^+) \text{ at } 28^\circ \text{ C.} \quad (12)$$

where E_o is a constant,

it is evident that the electrode potential as expressed in equation (11) does not exactly correspond to the assumptions made in the general theory. A further assumption must be made that the hydrogen ions of the solution are in some state of equilibrium with the hydrogen ions of the electrodes, the constant of equilibrium being

$$\frac{(H^+) \text{ solution}}{(H^+)^e \text{ electrode}} = 1$$

Another method may be followed of determining whether the electrode under investigation follows the assumptions made in the theory, using equation (10). According to this equation, the potential of the cell Al, BaO₂—HA—H₂Pt is constant, irrespective of the value of the hydrogen-ion concentration in the solution. Table 3, however, indicates decidedly that equation (10) is not followed. More experiments are needed to settle this point.

Experiments have been made to determine whether the Al, BaO₂ electrode could be used for determining pH in sugar juices. The results in the present study, however, show that the potential readings in sugar solutions are very erratic. It may be pointed out in passing that if the sugar solutions are first clarified and then allowed to stand for many days, the potential varies with the pH, approximately, according to equation (11). However, if the potential reading is made just after clarification or after extraction from the cane, the readings become very erratic. Furthermore, it was observed that the electrode did not work when buffers containing some amino acids were used. It would seem, therefore, that proteins exert a poisoning influence on the Al, BaO₂ electrode.

When the problem, however, is that pertaining to ordinary acid-base titration, the Al, BaO₂ may be used with advantage. Table 4 shows the difference in pH obtained by the hydrogen electrode and the Al, BaO₂ electrode according to equation (11). It may be seen, especially in conjunction with the graph, that between pH 7 to pH 10, the error is small. Furthermore, even if the behavior of the electrode is not according to equation (11), when the pH of the solutions are outside the range, the two electrodes give the same e. m. f. at the common hydrogen-ion concentrations studied, as may be seen from the graph.

An electrode that may be used for sugar work is the quinhydrone electrode. Although La Mer and Parsons (1923) have shown its inadequacy for acid-base titrations when the pH is greater than 8, and Farnnell (1925) has pointed out its unreliability above the same pH, it was observed in the present work that the errors involved are comparable with the ordinary color method, provided readings are always made exactly one minute after addition of the quinhydrone to the solution. Table 5 shows the pH readings by the hydrogen and the quinhydrone electrode. It will be noted that while between pH 6 to pH 7 the average deviation of the quinhydrone electrode over the hydrogen electrode is about +0.1 pH, this difference increases to +0.2 pH between pH 7 to pH 10 and the -0.3 pH from pH 10 to pH 11. The great difference in readings that La Mer and Parsons observed in their work was not observed in this study so long as the precautions pointed out in this report were observed. For approximate work, therefore, where a difference of 0.2 pH is negligible, the quinhydrone electrode offers possibilities even at higher pH.

SUMMARY

1. Of the many different electrode combinations for non-gas electrodes studied, the Al, BaO₂ combination was found to offer some possibilities.

2. While the behavior of the Al, BaO₂ electrode does not conform very strictly with that corresponding to the theoretical assumptions for non-gas electrodes, it was found to give reproducible values of the e.m.f. when used in ordinary acid-base titrations or in buffer solutions containing no protein impurities; the optimum range under which this electrode works lies between pH 7 to pH 10. An empirical equation for calculating the pH from the observed e.m.f. at the electrode is given.

3. The Al, BaO₂ electrode can not be used for determining the pH of sugar juices. For this purpose, the quinhydrone electrode may be used up to pH 10, if certain precautions regarding the time of reading the potential of the cell, after the quinhydrone is mixed with the solution, are observed.

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EXTENSION DIVISION NOTES

Progressive Farm Spirit

On the recent trip to the province of Leyte by Professors Aldaba and Elayda, one of their important visits was made to Mr. Daniel Javier's farm "Camalig" in the barrio of Bugjo in the municipality of Abutog in the eastern part of Leyte. Accompanied by Mr. Mauro G. Rodriguez, Agricultural Extension Agent under the Bureau of Agriculture, stationed at Tacloban, Leyte, we were hospitably entertained by Mr. Javier in his farm house for about two days, and were shown all his activities on the farm. This is a new farm being developed on public land purchased by Mr. Javier from the government in accordance with the Philippine land laws. Only a portion of the tract has been cleared and brought into a state of cultivation. A sort of diversified farming is practiced by Mr. Javier; he has found this system of husbandry to be fairly well suited to his purpose. His plan is to put the whole area into tilth for a coconut plantation, making the work preparatory for this end pay for itself. A detailed account of the personal management of this farm by Mr. Javier will be given later on.

Mr. Javier showed a keen interest in modern farming and in our agricultural and economic problems. Almost every waking hour of our stay was occupied in discussion of agricultural matters affecting his own enterprise and our country's agricultural situation in general. We sat up late into the night engaged in conversation on these topics. Mr. Javier is highly interested in the behavior of varieties of Philippine staples with regard to their profitable adaptation to different localities; in diversified cropping for a well-balanced agriculture as against specialized cropping; economical production as brought about by the different factors of production, such as more productive seed, maintenance of soil fertility by the application of green manuring and natural fertilizers, and labor-saving farm implements for planting, cultivation, and harvesting. The perplexing subject of marketing and market demand and prices that will give a profit commensurate with the farming outlay is a matter of interest to Mr. Javier. Also the keeping of farm records that enable the farmer to know more or less whether his farm business is a paying proposition or not, and the analysis of his farm practice so as to change and adjust his farming plan to the requirements of the time.

This discussion of agricultural topics certainly served as effective extension work. Mr. Javier was drawn closer to the College. Not a month has elapsed since our return from the Leyte trip that we have not been given a surprise by Mr. Javier. He came to the College Campus without

giving us warning. Apparently, he wanted to see how closely the farm practice we discussed with him on his Leyte farm is being followed on the College Farm and elsewhere. First of all, we took Mr. Javier on a drive through the province of Laguna to let him see the solid plantation of coconuts, bananas, rice, corn, sugar cane, and lanzon. These crops are all grown in Leyte, but in most cases not to the same extent as they are in Laguna. Except in some instances, coconut groves in Leyte are in small patches and only recently have plantations been laid out in big solid areas by replacing old abaca plantations or on extensive unoccupied areas. Banana plantations are also in small patches, and usually in house-yards. Lanzon trees in Leyte are found here and there mostly as specimen plants, and people have not as yet come to growing this fruit in continuous and extended plantations as in Paete and other Laguna towns. All told, Leyte is not behind Laguna in corn, rice, and sugar cane, except possibly in sugar cane. Sugar cane culture is almost negligible in the eastern part of Leyte, but considerable is raised in the western part, especially at Ormoc.

Returning to the College, Mr. Javier was shown the College Farm and farm methods by Professor Mariano B. Raymundo in charge of the College Farm Management course. Mr. Javier paid close attention to the following features on the College Farm:

1. Upland rice planting by a drilling machine and cultivation of drilled rice with a regular animal-drawn cultivator. By this method upland rice is set in uniform-distance rows which permits cultivation with an animal-drawn cultivator thus saving much in amount of seed and in dispensing with hand weeding and a good deal of hand labor.

2. Using the animal-drawn cultivator in corn and sugar cane field cultivation, instead of using the plow, a method never practiced in Leyte and not in vogue in the Islands. This practice prevents unnecessary destruction of roots and saves a considerable amount of time and labor, consequently lowering the cost of production.

3. Testing the newly introduced practice of growing lowland rice by direct planting of the seed in the permanent paddy. A late-maturing variety of rice is used, and is planted at the same time and treated at the beginning as is the upland rice. The field is not flooded. The rice stand is kept free from weeds with the use of the same cultivator as is used for upland rice. When the heavy rain comes the field is treated as a lowland rice field. It is flooded with either rain or with irrigation water. The habit of late maturing rice not being materially changed by this modified method, it is anticipated that it will give a positive result. In no other place in the Islands has this practice ever been tried. The probability of its becoming a more economical method than the usual one has made the experiment worth while trying.

4. For the practical and economical use of a tractor on the farm, the farmer himself must master the "ins and outs" of a proper handling of the

machine. With such knowledge on his part he can personally direct and supervise the working of a tractor when employing a tractor man, and it will thus prove an important factor in lowering farm expenses. It is expected that it will work that way whether the tractor is used as the principal motor power on the farm or as auxiliary to animal-drawn implements. The use of a tractor on the farm, however, is dependent upon the size of the farm, system of farming and management, farming outlook, and the amount of capital set aside for farm business. Above all, the farmer himself must live on the farm, run his farm operations, and study how to solve his own farm problems as related to the use of costly farm machines like a tractor.

5. Mr. Javier was shown that a blacksmith's shop is a necessary adjunct in keeping farm implements in working order and for durability and efficiency in doing the work. It may be a simple shop and except for the iron parts of it, most of the materials used in setting it up can be found on the farm, so are quite inexpensive.

6. Mr. Javier was shown that with the aid of the farm blacksmith, many of the imported farm machines, such as planters, row markers, cultivators, harrows, etc., were so adjusted and readjusted as to fit them for our local requirements in farm operations, so they can be used instead of hand labor thus saving time and energy.

7. He was shown the New College Copra Drier as it was built and operated on the College Farm. He was enthusiastic about it and hoped to introduce it in Leyte. Because of rainfall condition in that province, which is almost uniform throughout the year and practically no protracted dry season, this copra drier will save the farmers a lot of trouble in their copra drying. At present, their common practice is sun drying or in some cases the use of artificial heat drying by open air fire built on the surface of the ground below a bamboo trellis set up by bamboo poles in the air, on which the copra is spread. Either method is greatly interfered with by uncertain rainfall. Copra drying in Leyte in a copra drier, with a kiln dug out in the ground in about the same manner as the ordinary *tapahan* in Laguna, but with the difference that smoke is excluded from the copra, was found on one farm.

8. In the Animal Husbandry Department Mr. Javier was shown by Mr. Felix B. Sarao the entire procedure of making cottage cheese on the farm as an improvement upon the method used by native cheese makers in Laguna. The improvement in the College method consists in a more sanitary handling of the milk throughout the process, from the milking up to the packing of the cheese. In all the processes of the cheese making, care is taken not to touch with the operator's fingers the food material being handled. All utensils used in the operation are carefully washed with boiling water.

These are a few of the things that the College of Agriculture offers to our farming public by way of suggestions towards improving our farm

practice and farm economy. Every effort is made to adapt to actual practice on our farms what the College imparts to its students in the way of practical agricultural methods. This is a sort of an Extension demonstration, mainly given on the College Campus. Every farmer is welcome to it. And it is hoped that farmers of the type of Mr. Javier, a man up on the job—living on his farm and personally directing his farm work—will not only give the improvements they observe a fair trial on their farms, but will extend them to their neighbors once they prove them successful.

The Present "Granary" of the Philippines.

For a long time Pangasinan has been considered the "granary" of the Philippine Islands. But the province must now relinquish that honor to her sister province, Nueva Ecija. The sudden lead of Nueva Ecija in rice production which has given her the title that Pangasinan has held has been the subject of much discussion. The numerous factors that have contributed to so rapid an increase in production have been sought. Many factors must have contributed to produce such a great increase. The irrigation systems constructed by the Bureau of Public Works in some towns of Nueva Ecija and the intensive campaign for seed selection supposed to have been waged by the Bureau of Agriculture might have contributed considerably. But according to reliable information the greatest factor responsible for the increase is the recent very great influx of Ilocano labor into Nueva Ecija. This increase in population has resulted in an increase of rice acreage in the province. In these same years Pangasinan did nothing to restore its rice lands depleted through long years of cultivation without fertilization, and decreased its rice land area by converting it into sugar cane fields and coconut plantations. The increase of rice production in many towns of Nueva Ecija is really amazing. According to a personal investigation made by a graduate of the College of Agriculture, Mateo Jimenez, from Talavera, two towns, Cabanatuan and Guimba, produced more than a million cavans each in the 1925-26 crop. Cabanatuan with a population of 30,000 produced 1,390,000 cavans, and Guimba with a population of only 17,000 people produced 1,015,200 cavans.

Such an increase in production, especially of our staple food is a very encouraging sign from the agricultural standpoint. With towns with such small population producing a million cavans of rice a year it will not be long before we shall cease to import rice.

A Promising Farm Manager

Among the graduates employed by private concerns as farm managers the record of Irineo Maligaya of the class of 1925 is worthy of note. Just after graduation, Mr. Maligaya was employed as a farm manager by a wealthy *hacendero* in Negros. For two years he held that job with a very

commendable record. After two years of service he was allowed to take a two months' vacation in his home province. While on vacation he was offered position as manager of a farm in Nueva Ecija. The offer suited him well and he accepted it at once, with the agreement that he would be given a salary of ₱80 a month from date, October, but to be increased to ₱125 the following February. When the month of February came the owner being a man not wholly "on the square" wanted to evade the contract by making further promises to Maligaya as he thought that Maligaya would not leave him. But Maligaya insisted that the contract be kept or he would quit. His employer, appreciating the value of the services of Maligaya by the improvement he had made on his farm in the short time, decided he had better abide by the letter of the contract.

The farm on which Maligaya is working is a 1,000-hectare farm in Talavera, Nueva Ecija. It is a parcel of a 3,000-hectare farm owned by a rich family from Bulacan. The whole farm is managed by three men, one lot by Mr. Maligaya, another lot by Mr. Gregorio Francisco also a graduate of the College of Agriculture and with the distinction of being one of the few who holds the honorary degree of Master Farmer, and the third lot by an experienced farmer, though not with technical training. In this arrangement, the ability of Mr. Maligaya as a farm manager is being tested. In competition with two well-proven managers he will have to make very good. In spite of his few years of experience indications are that he will be able to keep up with his two colleagues and maintain the prestige of his college and make a name for himself as a farmer.

Co-operative Movement

It has been recently reported by the Department of Labor at Washington according to comment by *The Independent* in its June 25 issue that "Europe takes to co-operatives". According to the Department's own statistics there are 300,000 co-operative societies of all types that are functioning in Europe and an aggregate membership of 44,500,000 affiliated in them.

The most impressive feature of the movement is that it is not only producers who have organized co-operative societies but also consumers. "In twenty-two countries there are 50,000 consumer co-operative societies with a combined membership of 27,000,000 and annual sales of more than \$5,500,000,000." The activities of these societies include manufacturing and wholesale selling. "In 1925 the wholesale business in twenty-one countries aggregated more than \$800,000,000 and the value of goods produced in ten during the same year exceeded \$200,000,000. The English Co-operative Wholesale Society is the largest manufacturer, trader and landowner in the United Kingdom."

The percentages of population reached through co-operative societies given for various countries are as follows:-

United Kingdom.....	45%
Denmark, Finland and Hungary.....	40%
France and Russia.....	30%
Belgium, Germany and Sweden.....	20%
Australia.....	6%
United States.....	2.5%
Argentina.....	1%

This means that Europe is changing the old methods of buying and selling as "barter and trade between individuals" to collective exchange through co-operative associations.

It may be said that in the Philippines organized co-operative effort is hardly begun among crop producers, and only in a very few instances have co-operative merchandise stores been set up to serve the buying interests of small isolated communities. The best known and largest co-operative effort that has been launched and shows promise is represented in the "Tuguegarao Tobacco Growers Association" at Tuguegarao, Cagayan Province. This association was organized by tobacco farmers under the leadership of an agent of the Bureau of Commerce and Industry with the object of strengthening the bargaining power of the individual farmer with the collective effort of a co-operative association of farmers. It is also the object of this association to effect improvement in the financial condition of its members so as to enable them to improve the quality of tobacco they produce. Upon the initial success of this Association, tobacco farmers in other towns, such as Ilagan and Jones, Isabela, led by government agents have organized on about the same basis and for the same purpose as the Tuguegarao Association. Under private initiative and for a similar purpose tobacco growers at Bauang, La Union, have incorporated a Co-operative Association with a capital stock of ₱50,000 of which ₱26,000 is paid in. The last thing that was heard from this association was that its authorities have asked for the services of a competent government agent from the Bureau of Commerce and Industry to direct and push its co-operative activities.

That there is a demand for organized co-operative effort in the Philippines where economic pressure and narrow margin of living prevail among the inhabitants seems to be pointed out by the recent attempt of the Legislature through the Palarea bill on co-operatives "to provide legislation under which co-operative marketing associations may be established as stock associations." This attempt has been strongly indorsed by *The Tribune* (Manila daily newspaper) as a step in the right direction.

It may be asked, however, why not enact legislation in a more general way so as to include other types of co-operative societies, such as producer and consumer societies rather than limiting the provisions to co-operative marketing?

EXCHANGE NOTES

Any attempt to deal fundamentally with conditions of agriculture and country life must consider the existing status and efficacy of the rural elementary schools and their relations with any higher system of schools. The high standards attained in elementary education in Great Britain, France, Germany and earlier Poland, and some other countries in western Europe are matters of common knowledge. In large areas of continental Europe, however, especially in the eastern and southern countries, four rather serious shortcomings appear:

(1) Lack of any rural schools whatsoever. In parts of the Balkans, the two eastern provinces of Czechoslovakia, in large areas in Italy, Spain, and eastern Poland, elementary schools are not yet available to the children of farmers. In the eastern province of Czechoslovakia—a nation with peculiarly high educational ideals—there is 52 per cent illiteracy. It will doubtless yield to the efforts of this new and vigorous young republic, whose dominating purpose is expressed in its slogan “through culture to democracy”. In eastern Poland there is 70 per cent illiteracy. It is under attack. Within six years 10,000 new rural elementary schools have been established and 35,000 teachers added. The government asserts that 40,000 additional schools are required for the 1,000,000 farm children yet unserved.

—*World Agriculture.*

There is a great demand for peanuts overseas. France and Great Britain are the largest importing countries, while the Netherlands, Belgium, and Italy also import fairly large quantities annually. We cannot, however, export peanuts profitably until the cost of production is reduced by the greater use of machinery and the production of larger yields per acre.

—*Journal of the Department of Agriculture*
(Union of South Africa).

There are still many muscovado sugar mills in the Philippine Islands. Some of them are quite up-to-date, have galvanized iron roofs on them and are from 60 to 80 feet long. We found one mill of the older type near San Fernando in which some people were living now after the mill stopped functioning. The place had a steam engine manufactured by Aitkin Mc-Neil of Glasgow who sent many mills into the Islands years ago. All these mills have stone floors and they seem to be the landmarks of a departed glory in many sections on account of the coming of the centrals.

In Pangasinan, Philippine Islands, many muscovado mills still exist. Some of them use the Chattanooga mill made by the International Harvester Company. The Gonzales estate works up much cane in the primitive way. It originally had 26,800 acres which the French brought under subjection, but the Gonzales Sons have only 5,200 acres of it now. They use the caribou for transporting cane and they have the large clumsy carts with solid wood wheels which do the hauling. They plant the cane in checker-board fashion four feet apart and cultivate the cane with the caribou. Each mill employs from 15 to 20 men who get 80 centavos a day, though the boilers get 2 pesos a day. The season runs from 80 to 100 days a year.

—*The Planter and Sugar Manufacturer.*

As an indication of the value of agricultural extension work throughout the United States, the Experiment Station Record (Washington, D.C.) points out how the agricultural people themselves have taken hold to help develop this service, and how the taxpayers have willingly increased the support of this work.

In 1914 about \$1,600,000 was spent for extension work by the federal and state governments, while in 1924 this had been increased to \$19,394,000. Of this large amount, more than one-third (35 per cent) was paid by the county governments, 27 per cent by the state governments and 38 per cent by the federal government.

—*Extension Letter* (University of Hawaii).

Banana Trash.—There is a big problem here. It is stated, indeed, we think proved, that trash is the greatest carrier of Panama Diseases. The Laws regarding the use of trash are now very strict and will become stricter. It is the handiest packing material for bananas, or any product that we have. At present it should only be used to wrap bananas, and if taken out of a truck or waggon, and it touches the ground it must then be left to be burned. Even the burning is a problem, as when rain falls—and lately in most districts we have had three months of regular rains—the burning is difficult. The great point is the immense loss of fertility—the destruction of banana trash formerly taken back to the fields. How is to be made up?

—*Journal Agricultural Society* (Jamaica).

COLLEGE AND ALUMNI NOTES

By request of the Executive Committee of the College of Agriculture, for a period of thirty days, from July 22 to August 22, in respect for our late Dean and as an expression of our sorrow for his death, all flags were at half-mast, bands of mourning on the sleeve or knots of black ribbon were worn by the faculty and the students. No gatherings of a social or recreational nature were held. Quiet prevailed on the Campus.

The large enrollment, 842, in the College this year made it obligatory to change the order which has been followed so long of mass Student Body meetings. Our Auditorium is far too small for so large a body to meet for transaction of business. The Student Body constitution was amended making possible the organization of a representative Student Council. This council is now the students' governing body. It is composed of ten representatives from each class and ten from the two preparatory classes combined. These representatives must receive credentials from the Secretary of the College on their scholastic records which must be up to a certain standard. The officers elected at the first meeting of the Student Body this College year are officers of this first Student Council. Marcelo Peña is president and Victoria Mendiola is secretary.

The first meeting of the Council was held August 7. President Peña made a strong appeal to the members to stand for the principles so long upheld by the Student Body and so long counselled by Dean Baker. His closing words were: "Fellow students, we must not only follow the spirit of the noble and wise injunction to 'stand solid for the right, always,' the last counsel of our beloved Dean, but we must so preserve and obey his lofty words of guidance that those who come to this College when we are gone shall be benefited by the high ideal our kind Dean wished all students here to have for their aim."

By invitation, Dr. R. B. Espino, head of the Department of Botany, was present and addressed the Council. The theme of his address was, that with the distinction of being chosen to represent a class came responsibility; and that the Council must be true to the traditional Los Baños Spirit which means: Loyalty to College, to country; honest and high scholarship; clean living; co-operation, fellowship, and good sportsmanship.

Standing and special committees were appointed and other business transacted.

With a record attendance the Los Baños Biological Club began its fifth year at a meeting held in the College Auditorium on July 28, 1927, at 7:30 in the evening. As in past years the meeting was open to the public. Discussion followed each paper. Dr. A. K. Gomez, president of the Club, was in the chair. The following papers were presented:

Experimental studies on the etiology of osteoporosis: I. The heritable nature of the disease.—By Dr. B. M. Gonzalez and Dr. Valente Villegas. Paper was read by Doctor Villegas.

Notes on larval trematodes from Philippine snails.—By Dr. M. A. Tubangui.

Studies on the correlation between grain and straw production of cow-peas.—By Mr. Pedro A. Rodrigo.

Mr. Rodrigo's paper was not presented owing to his illness.

Letters from Mr. Eleuterio Palisoc and Mr. Virgilio Pineda, both B. Agr. '27, and Mr. Cipriano Baroon, B. Agr. '26, were recently received by Professor Yule. Mr. Palisoc, who is Junior Agricultural assistant with the Bureau of Agriculture, Sandakan, British North Borneo, writes:

I find my job immensely interesting and I am very glad that I accepted this position.

I think you will be interested to know that all the employees of the Department of Forestry and Agriculture are Filipinos, with the exception of those occupying low salaried positions.

Mr. Pineda writes:

My ranch (The Diamond P) lies thirty-five kilometers from the town of Cagayan. The automobile can go only as far as twelve kilometers of the way and the rest is a horse trail. . . . There are in my care about two hundred head of cattle. I am also engaged in farming and I believe that coffee will be my major crop. Of course I shall raise other crops to supply the household needs. Although we get excellent crops from rice and corn, I do not believe it will pay to go extensively into their production since the prime consideration here is the cost of transportation per unit weight. . . .

It is good for those living on the plains of Bukidnon who have roads, but within our district the best automobile is the pony and the truck is the back of the carabao. I find also that in the ranch house I have to play the dual rôle of master and housewife. It looks funny but I like nice things in the home and in the absence of a feminine hand the masculine is a poor substitute. There are divers other rôles which a fellow must play on a ranch and farm combined.

Mr. Cipriano Barbon, B. Agri. '26, writes that on November 14, 1926, he married Miss Caridad Mercado. He then resigned from his position as teacher in the Misamis High School and went to farming on Carinagan Farm.—To quote:

At present I feel the dire need of capital. However, I manage to raise some chickens and pigs. I expect to have a hundred or more hens by January of next year. I now realize the value of a centavo. . . . The lot of the small farmer is hard indeed, but I would not exchange my present work for that of a salaried man receiving my former salary of ₱1,080 per annum.

New books and other publications added to the Library, College of Agriculture, from April 7 to August 4, 1927

Administrative code of the Philippine Islands. 1917.

Allen, James

As a man thinketh.

America, poems of

Fifty best poems of America.

Bulzac, H. de

Christ in Flanders.

Barrie, James

A Tillyloss scandal.

Browning, E.

Sonnets from the Portuguese.

Browning, Robert

Pippa passes.

Browning, Robert

Poems.

Burns, Robert

Poems.

Church, F. J.

A trial of Socrates.

Coleridge, S. T.

The ancient mariner.

• Dante Alighieri

Inferno, Vols. I and II.

Dumas, A.

Contesse de St. Germain.

Emerson, Ralph W.

Essays.

England, poems of

Fifty best poems of England.

Fitzgerald, E.

The Rubaiyat of Omar Khayyam.

Gilbert, B. Y. W. S.

The "Bob".

Hale, E. E.

The man without a country.

Hamilton & Kidner

Advising the tuberculous. 1926.

Iowa State Board of Education. Report, 1926.

Ibsen, Henrik

Ghosts.

Irving, Washington

Old Christmas.

Kew bulletin, p. 537-963. 1922.

Kipling, Rudyard

Barrack-room ballads.

Kipling, R.

Finest story in the world.

Kipling, R.

The man who was.

Kipling, Rudyard!

Vampire and other verses.

- Kupfer, E.
Studies in plant regeneration. 1907.
- Larmer, F. M.
Financing the live stock industry. 1926.
- Lincoln, Abraham
Speeches and addresses of Abraham Lincoln.
- Longfellow, H. W.
The courtship of Miles Standish.
- Longfellow, H. W.
Hiawatha, Vols. I and II.
- Macaulay, T. B.
Lays of ancient Rome.
- Maeterlinck, M.
Pelleas and Melisande.
- Mayo Foundation Lectures.
Lectures on nutrition, 1924-1925.
- Poe, Edgar Allan
The murder in the Rue Morgue.
- Poe, E. A.
The raven.
- Shakespeare, W.
The comedy of errors.
- Shakespeare, W.
Midsummer night's dream.
- Shakespeare, W.
The tempest.
- Shaw, Bernard G.
On going to church.
- Sperlich, A.
Untersuchungen an blattgelenken, 1910.
- Stevenson, R. L.
Will O' the mill.
- Tennyson, A.
The coming of Arthur.
- Tennyson, A.
The Holy Grail.
- Tennyson, A.
Lancelot and Elaine.
- Thoreau, H.
Friendship and other essays.
- Turgenev, I.
Mumu and Kassyan of Fair Springs.
- Waites, G.
New South Wales statistical register, 1924-25.
- Washington, George.
Speeches and letters.
- Webster, Knowlton, and Hazen
A teacher's manual accompanying the Webster, Knowlton and Hazen European History maps—ancient section. 1924.
- Webster, Knowlton and Hazen
A teacher's manual accompanying the Webster, Knowlton and Hazen European maps, medieval and modern sections.
- Whitman, Walt
Memories of President Lincoln.

- Whittier, J. G.
Snowbound and other poems.
- Wilde, Oscar
Ballad of Reading gaol.
- Wilde, Oscar
The happy prince.
- Wilde, Oscar
The importance of being earnest.
- Wilde, Oscar
Salome.
- Yeats, W. B.
Land of heart's desire.
- Yule, E. S.
Stories from Japanese history. 1926.
- Ayrshire record, new series, Vol. VIII, 1891.
- Carter, H. R. (Editor)
The flax, hemp and jute yearbook and pocket annual, 1926.
- Hall & Nordhoff
The Lafayette flying corps. Vols. I and II. 1920.
- Kingsley, N. S.
Outlines of comparative anatomy of vertebrates. 1926.
- The local authorities handbook of New Zealand. 1927.
- Lundergardh, H.
Zelle und cytoplasma—Handbuck der pflanzenanatomie. 1922.
- Rusby & Jelliffe
Morphology and histology of plants, parts 1 and 2. 1899.
- Strasburger, E.
Die angiospermen und die gymnospermen. 1879.
- Thom & Church
The aspergilli. 1926.
- Tischler, G.
Allgemine pflanzenkarylogie. 1921-22.

NOTE:

Publications by C. F. Baker which are not in the list appearing in *THE PHILIPPINE AGRICULTURIST*, August, 1927, Vol. XVI, No. 3.

Dean Baker was ever on the watch that the list of publications by the College faculty be complete, but he seldom reported his own—whether from modesty or oversight through pressure of work we cannot say.

These additional publications were taken from the list prepared in the Philippine Bureau of Science Library after Dean Baker's death.

- BAKER, C. F. 1916. The biology of the Malayan Islands. *Science* 44: 878-881.
- BAKER, C. F. 1916. P. I. Tobacco Commission. Joint report on the economic and agromonic conditions in the Cagayan Valley in relation to tobacco—36 p.
- BAKER, C. F. 1918. Identity of a coconut hispid. *The Gardens' Bulletin* (Singapore), 5: 3.
- BAKER, C. F. 1920. To proposers of new genera. *Entomological News* 5: 19.
- BAKER, C. F. 1923. Comparison of neotropical and palaeotropical insect faunae. *The Philippine Journal of Science* 23: 531-532.
- BAKER, C. F. 1925. Nomenclatorial notes on the Jassoidea IV. *The Philippine Journal of Science* 27: 537.
- BAKER, C. F. 1926. Nomenclatorial notes on the Jassoidea V. *The Philippine Journal of Science* 30: 347.
- BAKER, C. F., AND C. HODEN KLOSS. 1927. *Spolia mentawiensia*: Homoptera-Fulgoroidea. *The Philippine Journal of Science* 32: 391-411. *Pl. 1: fig. 1-3.*

—Editor.

THE RELATION BETWEEN EMPLOYER AND EMPLOYEE¹

There are two apparently opposite currents of thought today which permeate the fabric of almost every institution. On the one hand, the love for an existence free from any forced dictation from higher authorities, coupled with the feeling that every effort made by an individual is for the enhancement of his personal interests, attracts not a few people to espouse a philosophy which H. C. Hoover aptly calls *individualism*. On the other hand, the recognition of the fact that in order to manufacture products at lower cost and thus be able to compete with a rival community and extend the enjoyment of material culture to a greater number a concerted and systematic effort of many individuals is necessary, led capitalists to form huge combines and employ executives and technical men of the highest caliber at high salaries. The first doctrine, I believe, is the outcome of a desire for self-expression which had long been suppressed by a system which disregarded almost entirely the feelings of a majority for what is thought to be the common good; the second is the outcome of keen competition in war and in the world markets.

While there is much to be said in favor of individualism, there can not be any doubt as to the greater efficiency derived from concerted efforts, and it would be well-nigh suicidal for the Philippines, if at this period in its development, when it has played hardly any part in the industrial exploitation of its natural resources, concerted efforts are not made in every line of endeavor called for in our economic development. This is particularly true in technical and purely scientific investigation.

In order to obtain, however, the maximum work from every individual, foster a fine *esprit de corps* and at the same time allow each one to develop full self-expression, there are a few requirements that an employer may follow to his advantage:

(a) That in the selection of individuals for positions of responsibility, only those of tested creative ability and high sense of responsibility be considered;

(b) That promotion be based upon the amount of investigations completed and their possible application;

(c) That aside from promotions, exceptional meritorious services be rewarded with emoluments of both honorary and pecuniary nature;

¹General contribution from the College of Agriculture No. 191. Received for publication August 10, 1927.

(d) That the salaries of the employees be set at a rate slightly higher than "starvation wages".

That the first requirement is of utmost importance is very evident. For an institution to turn out work which has a useful bearing upon the needs of the employer, the directive mind must possess not only a knowledge of these needs, but must also be endowed with the power to satisfy these needs. Originality, inventiveness, vision, the power to apply the oldest as well as the most recent principle discovered, and the ability to co-ordinate different lines of investigation and focus them on the problem at hand—these are the essentials of the leader. But we must not forget that in the discharge of his duties and in his attitude toward his superiors, his actions should be governed by his sense of loyalty to his employer and to his country, and by his sense of justice towards his subordinates.

It is generally recognized that merit should be the basis of promotion. But where the selection of the personnel is put in the hands of individuals who are not in direct connection with, or not directly responsible to the institution, a system sometimes arises where even the higher technical positions are filled by men incompetent to produce results expected of their positions. This is the essential difference between private institutions as the General Electric Company in the United States and government or state institutions as a university or a bureau. In the state institutions seniority is placed way above merit, resulting in dissatisfaction among the personnel and a possible acceptance by them of the philosophy of individualism.

In technical institutions where research is the "life-blood of their existence," the personnel are particularly careful in *recognizing merit where merit exists*. The employer could help in this by awarding meritorious services with some token of honor as a medal, or in some cases the conferring of an honorary degree or the giving of an honorary position. In some institutions as in the General Electric Company, new ideas, new inventions, in fact, anything that helps to improve its present products are given pecuniary awards.

I have already pointed out that the men of exceptional productivity are sometimes the very ones who leave an institution because of dissatisfaction with the system followed in the institution. In many cases, when the demand on the part of other institutions for men of their experience and training is great, they transfer to them. In the United States, men from universities and federal bureaus often leave them for employment in institutions where compensation is higher and responsibility greater. It may be pointed out, however, that the conditions in the United States do not as yet obtain here. In the United States the value of research work is fully recognized by commercial institutions, so that progress in science is carried on not only by the government but also by private institutions as well. To those who have the welfare of the Philippines at heart, it is dis-

couraging to think of our technical institutions being depleted of efficient men who accept more remunerative positions in industrial firms where facilities for investigation are meager—it is like killing the goose that lays the golden eggs.

Fortunately there are a few signs of hope for our technical personnel in our university and bureaus. The pension bill for civil service employees is a move in the right direction. The pension bill for university employees and the efforts now being made to allow sabbatical leave are in the same direction.

Furthermore, if in "lending" an employee to a private institution, his practical experience is greatly enhanced, thus enabling him not only to increase his earnings but also to increase his mental equipment and productivity, the employer should not only welcome such an arrangement, but encourage it.

It may now be asked, "what are the duties of the employee to the employer?" At the outset it may be pointed out that the formulation of these duties would be unnecessary if the employer at the start had selected his personnel on the basis of tested productivity and high moral sense. It may not, however, be amiss to enumerate a few demands of an employer upon his employees:

(a) The employee must be loyal to the institution which he serves. He should not draw full pay and devote most of his time to some outside work. If the employee works on a full time basis and uses the facilities of the institution, it should have some rights over his patentable or some directly useful work.

In case the demands of some private institutions come within the scope of his special line he may be allowed to do consulting work and to devote part of his time to these institutions, with or without pay from his own institution, depending upon the nature of the consulting work, provided this work does not in any way impair his efficiency and productivity in his own institution.

(b) For purposes of team work, he should see to it that he gets along well, not only with his superiors, but also with his equals and his subordinates.

(c) His training and experience must be of such breadth as to warrant his usefulness to the institution.

(d) In the laboratory, his cleanliness, accuracy, and general technique must be of the highest order.

(e) Although he has to perform routine work in an institution, such as a university or a state bureau, this should not impair his love and capacity for investigational work.

At the present time, the public does not sufficiently appreciate the benefits that may be derived from scientific and technical investigation. As a consequence of this, sufficient material and moral encouragement are not given the investigators. This results in little and insignificant pro-

duction. The effect of such production is to further lessen the confidence of the impatient public in the value of scientific work. Let it then be the duty of both the employer and the employee to work harmoniously in the acquiring of results which will ultimately benefit the people.

V. G. LAVA,
*Of the Department of Agricultural
Chemistry.*

READ, REFLECT, ACT

A short article, "Why Men Leave Teaching," by a former Yale teacher appeared in the April number of *The Yale Alumni Weekly*.

This former professor, who is now in business, after giving his reasons for resigning—the old familiar tale of salary being too low to meet reasonable living expenses and reasonable provision for future of family—makes some deductions that are worth the thoughtful attention of those who "pass sentence" upon the salaries paid College teachers.

To the individual teacher personal responsibility to his family must be paramount. If the pressure becomes too great, he will leave the institution where he is working. And on the whole the institution, especially if it is large and well-organized like Yale, will be affected only in a small measure. The gap will be closed. The work will go on. The individual forgotten. In a larger sense the greatest loss to Yale does not come from the loss of the men who leave but more from the consequences of low salaries to the men who remain or who fail to come to her faculties.

And here is where lies the chief importance of the experience which is sketched above. My pitifully small salary was rapidly lowering my efficiency as a teacher and scholar. And now in the perspective of the years which have passed, I believe that it was an actual gain for the University to have me go. Let me be a little more specific: The continual nightmare which came from inadequate insurance, cramped living quarters, the lack of a larger social life, the lost opportunities to travel either for purposes of study or of general culture—all of this and much more was making me less productive as a scholar and less effective as a teacher. Even worse than this was the fact that for the last three years that I was in New Haven, I spent my summers in outside work in order to gain an additional income which would balance my budget.

Now anyone who knows what makes for the healthy development of a teacher and scholar knows only too well that the vacation period which is cynically known by outsiders as a long period of loafing must be made the period of most intensive work. The growth of a teacher's ability to inspire students depends inevitably upon the growth of his mind in scholarly study and research. Research is not antagonistic to good teaching but absolutely essential to it. Without it the teacher becomes a routine drill master of a value which constantly diminishes with the years. Any system which makes it necessary for teachers to spend their summers in prostituting their intellects by teaching in summer schools, or to spend their time in any other way than in that which directly promotes a constant deepening and enrichment of the mind is, in my opinion, a shortsighted policy. The greatest efficiency of the individual is made possible.

Conditions at Yale have been improved somewhat since I left but they have been affected to such a limited degree that the basic condition which drove me from its walls still obtains. Few appreciate what is owed to the loyal men who, instead of leaving as I did, have stayed at their posts.

I want to say with all sincerity that I have met in high places in business more lack of ability and more inefficiency than I ever found upon the Yale Campus among those who make up the staff of her teachers. In fact, I know of no single body of men anywhere who have greater ability and who do their work quite so well. It is high time that they receive more generous treatment at the hands of the University, which alone can be made possible by increased endowment.

PROGRESS OF TOBACCO CO-OPERATIVE MARKETING IN CAGAYAN¹

PABLO N. MABBUN
Of the Department of Rural Economics

In 1925 when I made the first study of the Tuguegarao Tobacco Growers' Association Inc., there were only thirteen barrios covered by the association. These barrios are all in the municipality of Tuguegarao. I visited the Cagayan Valley again from May 26 to June 14, 1927, and found that the association has grown tremendously in the past two years. The association now has branches in the towns of Solana and Peñablanca, Cagayan. The membership has increased from 500 in 1925 to 2,029 at the close of the year 1926. The main association in Tuguegarao has increased its membership from 500 to 1,379. The branches of the association in Solana and Peñablanca have memberships of 592 and 58, respectively. This gives the total membership of 2,029.

Judging by indications, the membership will increase this year. The technical adviser of the association told me that a branch in Piat, Cagayan, will be ready to transact business during the current year.

The branches in Solana and Peñablanca are controlled by the central office of the association in Annafunan, Tuguegarao. They are managed by committees in the same way as the barrio organizations are handled (Mabbun, 1927).²

VOLUME OF BUSINESS OF THE ASSOCIATION IN 1926

Owing to the difficulties which the association met in 1926 in dealing with the buying companies which constantly try to suppress its activities, the sales of the tobacco by the members did not take place until November. The general sales of tobacco in the province commenced in August, but the association could not attend to marketing of its product at once. It had to first adjust differences which had arisen between it and the agents of the Compañía Tabacalera. This company had contracted to buy the tobacco of the association but finally withdrew from the contract.

In spite of this trouble which temporarily paralyzed the business activities of the organization, the association sold its tobacco to other buyers in the province. Table 1 shows the volume of business the association

¹ Experiment Station Contribution No. 462. Received for publication June 29, 1927.

² Mabbun, Pablo N. 1927. Study of the Tobacco Growers' Association, Inc., of Tuguegarao, Cagayan. *THE PHILIPPINE AGRICULTURIST*, 16: 19-33.

transacted during the year 1926. These data cover both the main association in Tuguegarao and its branches in Solana and Peñablanca.

TABLE 1

Showing the result of the sales of the tobacco of the members of the Tuguegarao Tobacco Growers' Association, Inc., and its branches for the year 1926

The Main Association in Tuguegarao

BARRIOS	NUMBER OF LOTS	NUMBER OF FAMILIES	TOTAL AMOUNT	TOTAL COST	COMMISSION RECEIVED
			<i>palillos</i>	<i>pesos</i>	<i>pesos</i>
Annafunan.....	231	639	189,939	16,051.04	2,081.35
Atulayan.....	11	22	4,561	288.29	45.00
Bagay.....	30	90	30,629	2,291.85	306.29
Buntun.....	12	36	15,600	1,093.29	155.20
Capatan.....	25	75	25,565	2,135.56	255.65
Cataggamman.....	48	144	94,982	7,721.24	391.07
Larion.....	6	18	8,613	748.42	86.13
Libag.....	45	100	55,166	4,799.03	551.66
Namabbalan.....	9	27	7,212	623.83	72.12
Pal-lua.....	42	126	31,896	2,362.51	322.21
Ugac.....	16	48	24,600	2,581.00	246.00
Miscellaneous.....	—	—	16,858	492.39	25.11
Total.....	475	1,379	498,721	41,188.45	4,537.79
<i>Solana Branch</i>					
Andarayan.....	54	162	62,075	4,810.00	436.00
Bañgag.....	41	123	36,793	1,344.28	309.46
Bauan.....	21	42	26,281	916.16	200.00
Basi.....	3	10	5,947	312.89	56.00
Calamagui.....	22	60	22,350	2,889.90	223.50
Centro.....	15	45	14,028	899.13	113.40
Lanna.....	6	18	5,089	469.83	50.00
Miscellaneous.....	44	132	32,200	1,288.00	200.00
Total.....	206	592	204,763	12,930.19	1,588.36
<i>Peñablanca Branch</i>					
Lagum.....	29	58	37,872	2,644.62	300.00
Total.....	29	58	37,872	2,644.62	300.00
Grand total, main association and branches..	710	2,029	741,356	56,783.26	6,426.15

The table shows that the association sold a total of 741,356 *palillos* (6,309 quintals) of tobacco valued at ₱56,783.26. This amount was distributed as follows: The main association in Tuguegarao sold 498,721 *palillos* at ₱41,188.45; the Solana branch, 204,763 *palillos* at ₱12,930.19; and the Peñablanca branch, 37,872 *palillos* at ₱1,588.36. The association did not sell all the tobacco holdings of its members. It rejected unsound leaves; these represented from 20 to 25 per cent of the total holdings of

the entire membership of the organization. These rejected leaves had been eaten by weevils, or were moldy or dirty and torn. Such leaves, if sold, would injure the good name of the association.

It is the policy of the association to sell only sound leaves so as to earn a good name for the association and also to impress the members with the advantages of keeping tobacco of good quality for sale.

Out of the total sales by the association, which amounted to 741,356 *palillos* valued at ₱56,783.26, it received commissions amounting to ₱6,426.15. In 1925, the association received a total commission of ₱5,576.63. These commissions, amounting to ₱12,002.78, form a large sum from which to make loans to members and to pay for improvements for the association.

The commission is based not upon the value of the product sold but upon the quantity delivered, which accounts for the commission in 1925 being smaller than in 1926, although the value of tobacco sold, ₱64,302.15, was greater. The buyers generally give commissions ranging from 50 centavos to ₱1.00 per 100 *palillos* delivered to them.

Prices

The main association in Tuguegarao received prices ranging from ₱10 to ₱11 a quintal for the tobacco it sold and the branches in Solana and Peñablanca received from ₱9 to ₱9.50 a quintal. The difference in price was due to quality of tobacco. The Tuguegarao farmers had learned by experience in 1925 the advantages of having a better quality of tobacco, hence, tried to improve their product. The result was that the buyers gave higher prices for their product than they gave the members of the branches in Solana and Peñablanca.

These prices, however, are very much higher than prices received by non-members. Tobacco of the same quality as that sold by the association in 1926 was bought by organized companies from non-members at prices ranging from ₱6 to ₱9 a quintal. Individual tobacco buyers (unorganized) bought the same quality of tobacco at prices ranging from ₱8.50 to ₱10 a quintal.

In 1925, the association received better prices for its product. The prices the association received that year ranged from ₱10 to ₱15 a quintal. Non-members received from ₱9 to ₱10 a quintal for the same quality of tobacco. The difference in the prices obtained in the two years may be explained by the fact that in 1925 production was low and the demand was great while in 1926 production was heavy and there was a consequent decrease in the demand. Many of the buying companies reduced their purchases during 1926.

The low prices received by the association for its tobacco in 1926 accounts for the smaller income it received for the tobacco than in 1925, despite the greater quantity of tobacco marketed.

Sales

The tobacco of the association was sold collectively, as in 1925. The association divided the farmers (members) into districts and sold each district to the buyer offering the most advantageous terms. To prevent buyers buying only selected lots, individual sales were not permitted by the association. Despite this effort there were a few members in Solana who sold their tobacco individually because they could not wait for the collective sale by the association. The association permitted these individual sales so that the members might learn the disadvantages of making transactions in this manner; thus strengthening their faith in the organization. These members received very low prices, only from ₱5 to ₱7 a quintal, while members in the same locality received from ₱9 to ₱9.50 a quintal for the same quality of tobacco from collective sale by the association.

TABLE 2

Giving names of companies and persons to whom the association sold tobacco and the quantity and value of sales

NAME AND ADDRESS	QUANTITY	VALUE
	<i>palillos</i>	<i>pesos</i>
John Lohmann Co., Tuguegarao.....	481,160	37,364.10
Alhambra, Tuguegarao.....	64,805	7,080.89
Insular, Tuguegarao.....	60,445	3,731.29
F. Lim Tak Co., Tuguegarao.....	67,847	4,654.36
Severino Pagalilauan, Peñablanca.....	6,847	445.19
F. Lim Tek Co., Tuguegarao.....	31,069	2,219.43
Individual Chinese, Solana.....	29,183	1,288.00
Total.....	741,356	56,783.26

The association followed the same sales policy as in 1925, that is, controlling the product of its members so as to secure a price without reference to supply and demand. The association held the tobacco of its members refusing to sell until it was able to secure the most advantageous price. This price was higher than that offered for tobacco of the same quality belonging to non-members. It succeeded in doing this, but the price it received for the tobacco of its members, crop 1926, was very much lower than for tobacco of nearly the same quality in 1925. This difference was due to the influence of demand and supply. In 1925 there was great demand for tobacco as the production was low, but in 1926 the production was high and the demand was low, hence the low price. Many of the buying companies bought smaller quantities of tobacco in 1926 than in 1925.

Classification

The tobacco of the association was classified in accordance with instructions given to its members. The method of classification is the same as that given by Mabbun (1927).³

³Mabbun, Pablo N., *loc. cit.*

In an effort to improve the method of classification of its tobacco the association tried to introduce the old method used during the Tobacco Monopoly in the Spanish régime, that is, separating the leaves into bundles called "hands", each hand containing 100 leaves, of similar length and size. This method of classification would bring better prices than the method now used by the association, but it requires from the farmers much time and patience. The association succeeded in inducing 130 families to classify their tobacco in this manner. Their product amounted to 400 quintals. These members received higher prices than those who sold their product through the association in the loose form. The association expects that more members will follow the old method of classification next year and thereafter and hopes it will be finally adopted when the members realize the advantages of arranging their crop in this manner.

Delivery

Tobacco bought from the association was delivered by the members individually at the expense of the buyers. (That the members bore this expense as stated on p. 24 in Mabbun (1927) is an error.)

Storing

The Tuguegarao association has no warehouse. The members still keep their product in their own houses as they did in 1925. The association, however, is planning to build a warehouse 18 by 17 meters of mixed material in Annafunan, Tuguegarao. The material for the construction of this warehouse has been bought and the technical adviser of the association told me that they will try to have this building finished and ready for use before the end of the current year.

One warehouse for the whole association having a total membership of 2,029 will be inadequate, but it will be a good beginning. As soon as this one is built and used by the farmers it will be easy to induce them to build more.

I had occasion to talk with the provincial governor, Mr. Proceso Sebastian, regarding warehousing facilities for the tobacco farmers. He told me that he favored the idea of urging the government to build warehouses for the tobacco farmers, as it would help to improve the quality of their product. This need of warehousing facilities by the association was discussed in my former paper (Mabbun, 1927).

OTHER ACTIVITIES OF THE ASSOCIATION

Loans

Most of the farmers who joined the association in the barrios of Capatan and Libag in 1925 were heavily indebted to Chinese tobacco buyers. The association urged these members to square their accounts after they received their shares of the proceeds of the sale of the tobacco of the association, crop 1926. This they did but were left penniless. They had to borrow money

to pay their living expenses. The association met this demand of its members by lending them money at 12 per cent per annum.

As a matter of policy, the association decided to limit the amount of loans to from ₱5 to ₱20 to each individual borrower. The money borrowed in most cases was for buying food supplies, medicine, and for paying matriculation fees for school children and buying their books. Occasionally, loans for weddings, baptismal celebrations, and patron saint fiestas were granted, but such loans were discouraged by the association by appealing to the sense of economy of the members and by persuasion.

The association has been granting loans for purely consumptive purposes during last year. This was unavoidable as the members in most cases had to have money and if the association had refused to grant loans the members would have borrowed from private persons at exorbitant rates of interest and given as security their crop. This kind of a debt would hamper the marketing business of the association. Besides, there is the danger of losing the trust of the members in the organization if they were refused loans.

Table 3 shows the extent of the loaning business of the association in 1926.

TABLE 3

BARRIOS	NUMBER OF MEMBERS GRANTED LOANS	AMOUNT OF LOANS
		<i>pesos</i>
Annafunan.....	64	568.75
Capatan.....	45	519.12
Libag.....	55	441.00
Cataggamman.....	15	206.00
Bagay.....	22	169.00
Namabbalan.....	9	76.00
Pal-lua.....	9	35.00
Atulayan.....	8	60.00
Buntun.....	3	15.00
Ugac.....	3	20.00
Total.....	233	2,109.87

This table shows that the association granted loans to 233 members, the total amounting to ₱2,109.87. All of these members belong to the main association in Tuguegarao. They represent 11.43 per cent of the entire membership of the organization, including its branches in Solana and Peñablanca. The association has not yet extended its loaning business to the branches in Solana and Peñablanca.

Taxes

Many of the members of the association, including the branches, were not able to pay their taxes in 1926 because of lack of money owing to the low prices of tobacco and the delay of the sales of that held by the association. The association tried to help the members out of this difficulty by paying the taxes of several. These advances the association considered as loans and payable from the proceeds of the sales of the members' crops for the current year.

Table 4 shows the result of the activity of the association in this direction.

TABLE 4

BRANCHES	BARRIO	NUMBER OF MEMBERS HELPED	AMOUNT OF TAXES IN PESOS
Tuguegarao:			
“	Annafunan.....	78	573.99
“	Capatan.....	19	110.89
“	Cataggamman.....	62	388.31
“	Libag.....	50	280.62
“	Namabbalan.....	10	50.00
“	Pal-lua.....	12	75.41
Solana branch:			
“	Andarayan.....	48	320.00
“	Bañag.....	37	295.00
“	Bauan.....	17	224.00
“	Centro.....	10	136.00
“	Basi.....	3	25.00
Peñablanca branch:			
“	Lagum.....	15	300.00
Total.....		361	2,779.22

This table shows that the association paid taxes for 361 members, or 17.79 per cent, amounting to ₱2,779.22. This activity of the association helped very much to strengthen the confidence of the members in the organization.

Co-operative stores

In 1925 when I made the first study of the co-operative marketing association in Tuguegarao there was established and in operation one co-operative store in the barrio of Annafunan, the place where the central office of the organization is located. This store sells goods to the members of the association and to the general public.

The number of co-operative stores managed by the organization has increased to three with the growth of the membership; two are in Tuguegarao and one in Solana.

These stores serve as a medium to control the members of the co-operative marketing association. They also serve the community by bringing to them stores where they can buy articles for every day needs. These stores, too, serve to awaken the people to the wide opportunities for business

undertakings through co-operative effort. The association hopes to establish more of these co-operative stores from time to time.

The association further helped its members by supplying them with corn and rice during the months of March, April, May, and June last year when there was scarcity of these grains in the locality. The association imported rice and corn valued at ₱600 and distributed these at cost to the members in great need of them, and even sold these cereals on credit to those who could not pay cash.

OBSERVATIONS

As conclusions from these two studies would be premature, I shall make no attempt to make any based on my knowledge of the two years' activities of the organization. I am, however, giving herewith some observations which I made when I conducted these studies.

1. I observed that the tobacco planters of Cagayan are beginning to appreciate the advantages of co-operation. The majority of those to whom I talked expressed approval.

2. The people in other parts of the province are beginning to look with favor upon the co-operative movement in marketing tobacco. Former opposers of the movement are now supporting the organization. *La Verdad*, a weekly which was the organ of the enemies of the co-operative movement, is now publishing editorials favoring co-operative marketing of tobacco and the methods of classification of the product used by the Tuguegarao Tobacco Growers' Association Inc. Ex-Governor Lasam of the province, the foremost leader of the opposition to the co-operative idea of marketing tobacco, now supports the association. He is the editor of *La Verdad*.

3. One weakness of the association is the employment of a man as president who has had no training and experience in the tobacco business. A man who is well-versed in the tobacco business should be employed by the association if it is to do good business. One reason this president was elected by the association may be that he is a lawyer and can look after any legal business of the organization. This may be an advantage but not from a business point of view.

4. Much has been done by the association in teaching the tobacco farmers how to improve the quality of their product. More could be accomplished in this direction if the association would adopt rules and enforce them requiring the members to produce the same or nearly the same quality of tobacco. Rules, such as those adopted by successful co-operative marketing associations like the California Fruit Growers' Exchange, concerning the production of similar grades of product could be adopted, with modification to suit conditions, by the Tobacco Growers' Association Inc. of Tuguegarao.

5. Also curing houses and warehouses for the use of the association would help to improve the quality of tobacco produced by the members.

6. The organized companies in the province buying tobacco are constantly trying to defeat the purposes for which the co-operative marketing association was established. They use all kinds of tricks to destroy

the faith of the members in the organization. The leaders of the co-operative marketing associations should try to win the sympathy and friendship of these well-organized tobacco buyers.

7. The association should endeavor to have its members adopt the classification of the leaves into "hands," as this method of classification is demanded by the best tobacco buyers in the province, such as Weber and Co., and others. Mr. Weber claims that tobacco classified in this manner is cleaner and will not get moldy as easily as tobacco classified in loose form.

8. Lastly, I observed that the co-operative marketing association in Cagayan is growing very fast; it will not be long before a network of co-operative marketing associations among tobacco farmers will cover the province.

THE ILAGAN TOBACCO GROWERS' ASSOCIATION, INC.

I went to Ilagan, Isabela, twice with the object of getting data about the business transactions of this association, but I was not able to meet Mr. Peña, the agent of the Bureau of Commerce and Industry directly in charge of this association. He was on a business trip to Reina Mercedes, Isabela, on both occasions. The report that I herewith submit on the Ilagan Tobacco Growers' Association Inc. consists of what information I could get from some members of the organization, from the personnel of the Tobacco Experiment Station in Ilagan, and from Mr. Marcelo Adduru, the agent of the Bureau of Commerce and Industry in Cagayan and the organizer of both the Tuguegarao and Ilagan associations.

Organization and management

The Ilagan Tobacco Growers' Association Inc. was organized in 1924 and incorporated during that same year. The organization and management of this association is similar to that of the Tuguegarao Tobacco Growers' Association Inc.

Growth of the association

In 1925, the association had 201 members. In 1926 this number had increased to 322. As Ilagan is nearly as large as Tuguegarao it seems as though the growth of the association is very slow. One reason for this may be that the influence of the Tabacalera Company among the tobacco farmers in that locality is very great. This company employs many of the tobacco farmers as tenants on its *hacienda* in the barrio of San Antonio, Ilagan. Besides, the office of the Chief Agent of the company for the whole Cagayan Valley is located at Ilagan. This company has always been antagonistic to the business activities of the co-operative marketing associations in the valley.

Sales

Individual sales of tobacco by the members is permitted by the association. This explains why only 232 quintals of tobacco of members were sold through the association in 1926. It would have been able to sell more than 1,000 quintals had all the members sold their product collectively through the organization.

Prices

The prices received by the members of the Ilagan association in 1926 ranged from ₱14 to ₱15 a quintal. Non-members received from ₱8 to ₱12 a quintal for the same quality of tobacco as that sold by the association.

The association received a commission of about ₱700 for the sale of the 1926 tobacco crop of its members. In 1925 it received about ₱1,000 as commission. The fact that in 1925 the prices for tobacco were higher than in 1926 and the association marketed the tobacco of the majority of its members collectively, while in 1926 only 232 quintals of members' tobacco were marketed through the association, explains the difference in the amounts of commissions in the two years.

Delivery

Delivery of association tobacco to buyers was done individually by the members as the association has no warehouse where the tobacco can be stored in common. This method of delivery is the same as that described for the Tuguegarao association (Mabbun, 1927).

OBSERVATIONS

1. The discipline of the members of the Ilagan association is lax. It should be strengthened. Many of the members market their tobacco individually because they cannot wait for the sale of their product collectively by the association.

2. On account of the presence of the Tobacco Experiment Station in Ilagan where the tobacco farmers observe the methods used in improving quality of the product, the association has done little for its members in this direction. The farmers themselves improve their methods through observation on the Experiment Station. This is one advantage the Isabela tobacco farmers have over the Cagayan tobacco farmers.

3. On account of the *hacienda* of the Tabacalera Company which employs many farmers as tenants, being in the locality, the growth of the association has been very slow. Most of these tenants do not join the association because their landlord is against the co-operative movement.

4. There is an effort to extend the co-operative marketing in the province by the agents of the Bureau of Commerce and Industry who are working there. They plan to establish associations in the towns of San Pablo, Santa María, Naguilian, and Echague, Isabela, next year. One of these agents has started a campaign in San Pablo and it is reported that the association in that town will be ready to do business before the end of the current year.

ACKNOWLEDGMENT

I am indebted to Mr. Marcelo Adduru, to the personnel of the Tobacco Experiment Station in Ilagan, Isabela, and to the members of the co-operative marketing associations for the information they kindly gave me.

A STUDY OF THE HISTORY, FEEDING, AND MANAGEMENT OF RACE HORSES RUN UNDER THE AUSPICES OF THE MANILA JOCKEY CLUB^{1, 2}

VALENTIN K. LINA

The value of a light horse depends primarily on its speed and endurance. Race horses, therefore, may be considered as playing an important rôle in constructive breeding operations because their performance is necessarily a criterion of their worth, and an indication of the ability of their sires to produce poor or good offspring. Thus, a study of their history and management is interesting, and appropriate, and should be of value.

This investigation was conducted in Manila, covering a period of one year and eight months, from June, 1925, to February, 1927. The specific objects were as follows: (a) To determine the origin, color, height, and performance of first purse winners among the horses run under the auspices of the Manila Jockey Club; (b) to ascertain the kinds and amount of feeds given to race horses; (c) to secure data on the details of management of race horses.

MATERIALS

The records of 324 horses winning first purse were studied; two were from China, four from Arabia, four from Australia, and the remainder from different provinces in the Philippines. Out of this number only four were females.

In studying the history of these horses the record books of the Manila Jockey Club and the Batangas breeding station were examined. Eighteen stables were examined to secure data on the management of race horses. A spring balance was used in determining the consumption of feeds by the animals.

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²The writer is indebted to the officials of the Manila Jockey Club for permission to use the record books of this organization; to Messrs. A. B. Marthenis, A. Lozada, F. Rodriguez, E. Trinidad, L. Tiemchong, J. Mortera, F. M. Jhocson, Q. de Vera, M. P. Marcaida, A. Valero, J. Robles, J. Zulueta, J. Alba, P. Magallanes, R. Montañes, E. Sagarbarria, A. Ansaldo, A. Nieto, and E. Marcelo, stable owners and managers, for allowing the writer to carry out observations on their horses and stables; and to Mr. Benito Vergara, an experienced jockey, for information connected with the different phases of this study.

PROCEDURE

In the study of the history of the race horses, the following points were considered: name of animals, owner, color, height, origin, and performance. Whenever possible, the ancestry of the animals was also obtained from any record available.

To obtain information on the management of the horses, observations were made on the feeding and handling of all horses in the different stables investigated. These were made with each stable for five consecutive days. In the meantime, questions were asked the managers, or owners of the stables, and the grooms and jockeys regarding other phases of management.

DISCUSSION OF RESULTS

Origin

From the beginning of the operations of the Manila Jockey Club the winning horses came from Batangas, Camarines provinces, Cebu, Cavite, Negros Island, Misamis, Pampanga, Bulacan, Manila, Davao, Mindanao, Pangasinan, Nueva Ecija, Cagayan, Albay, Leyte, Bataan, Jolo, Laguna, Rizal, Ilocos provinces, Abra, Zambales, Zamboanga, Tayabas, and Romblon. The winning horses from foreign countries came from Arabia, China, and Australia.

Of the provinces in the Philippines, Batangas leads in producing the greatest number of winners, or a total of 136 horses. The Camarines provinces rank second, with a total of 37 horses. Then follows Cebu, having 30 horses to its credit. Cavite has 13 horses and Negros Island and Misamis have 11 each, while Bulacan and Pampanga each have 10 winners. The other provinces have less than 10 animals each. Among the foreign countries, Arabia and Australia have four horses each and China has two.

Color

The most common color among the horses was bay. Other colors of great frequency among the native horses were gray, buckskin, and roan. The other colors represented by Philippine horses were chestnut, cream, black, piebald and skewbald, and mouse color. There were three horses of unknown color. Of the foreign horses, besides bay, the colors registered were chestnut, roan, and piebald or skewbald.

Height

Looking into the frequency distribution of height in table 2, it may be seen that among the native horses, the most common height was 51 inches, this being followed by 50 inches. Most of the horses measuring 48 inches were those that ran in the early days of the Manila Jockey Club. The tallest horse measured 55 inches. The average height was 50.9 inches.

Among the foreign horses, the most frequent height recorded was 57 inches. The tallest animal registered measured 60 inches; it was from Australia. The lowest was 52 inches, the height of two horses from China. The average height was 55 inches.

The Manila Jockey Club

In presenting the performance of winners in the Manila Jockey Club, it is necessary that a general statement of the functions of the club and history of the races held under its auspices be given as a background for correct interpretation of the performance of each animal.

The Manila Jockey Club had its track in Santa Mesa from 1887 to 1900. In 1901 there were no races. In 1902 the track was transferred to San Lazaro, where racing has been held from that year to the present.

The functions of the Manila Jockey Club are:

- (a) To maintain the race course in good order.
- (b) To supervise the classification and running of horses in the track.
- (c) To provide judges for the races.
- (d) To provide for purse money for winners in the races.
- (e) To exercise vigilance that dishonest jockeys use no tricks while racing, and, when found guilty, to punish them.
- (f) To sell race tickets and pay dividends to winning holders of same.
- (g) To keep records of horses admitted to the races.
- (h) To distribute and sell programs to the public.
- (i) To promote in the best way possible means that tend to improve racing.

Classification of races

In 1889 the races were classified as follows:

- a. Carrera de Velocidad
- b. " " Luzon
- c. " " Lipa
- d. " " Pampanga
- e. " " Batangas
- f. " " Albay
- g. " " Camarines
- h. " " Marquez
- i. " " Combate
- j. " " Compensación
- k. " " Consolación
- m. " " Filipinas

The names given above were simply designations, in many cases, in honor of certain provinces. No specific requirements were attached to each.

At present the kinds of races are:

- a. Carrera de novatos
- b. " " vencedores de novatos
- c. " " perdigones de novatos
- d. " " 5a serie
- e. " " perdigones de 5a serie
- f. " " 4a serie
- g. " " 3a serie
- h. " " 2a serie
- i. " " 1a serie

The *a*, *b*, and *c* races are subdivided into two groups, one group for the native horses and the other for the grades (mestizos). Races of the *c* group are always provided, but seldom run, because no horses are entered for the group.

a. *Carrera de novatos* (novices). This race includes all newly entered horses. The animals carry no extra weight outside that of the saddle and jockey.

b. *Carrera de vencedores de novatos* (winners in the novices). All horses winning first place in *a* are promoted to this class. Upon entering this race a total weight of 110 pounds, including the weight of the saddle and jockey, is placed on the animal. With a horse winning first place an extra weight of four pounds is added to the load in the next race until and including the third winning, when the total weight carried is 122 pounds. After three first place winnings native horses are raised to the "*Carrera de 5a serie*" while the grades are promoted to the "*Carrera de 1a serie*". Two second place winnings are reckoned as equivalent to one first place. Horses getting second place in the races are weighted two additional pounds at each winning, until 122 pounds is reached. A horse in this class carries one pound of weight less each time it loses a race, until the minimum load of 110 pounds is again reached.

c. *Carrera de perdigones de novatos* (losers in the novices). Horses losing in the "*Carrera de novatos*" are demoted to this class and carry no load other than the jockey and saddle.

d. *Carrera de 5a serie*. As given above, native horses winning first place in the "*Carrera de vencedores de novatos*" three times are raised to this class. Also, losers in the "*Carrera de 4a serie*" within six months of consecutive racing are demoted to this class, whether the animal be a native or grade. The initial weight carried by horses promoted from "*Carrera de vencedores de novatos*" is 110 pounds, while those demoted from the "*Carrera de 4a serie*" start with a load of 120 pounds. A horse starting with a weight of 110 pounds that wins first place is made to carry 114 pounds the first time it wins a race; 118, the second; 121, the third; 123, the fourth; and 125, the fifth race. The horse is then raised to the "*Carrera de 4a*"

serie." Upon losing, the load of horses in "5a serie" is lightened at the rate of one pound each time until the minimum load of 110 pounds is reached. Horses in "5a serie" demoted from "4a serie" are raised again to the "Carrera de 4a serie" upon getting one first place or two second places in the first mentioned classification. But if they lose, a decrease of two pounds on their load is made each time until 110 pounds is reached. Such demoted horses as carry a load of 110 pounds or higher, but below 120 pounds, on winning first place in a race, are made to carry 120 pounds the next race.

e. *Carrera de perdigones de 5a serie.* In the same way as in the "Carrera de 4a serie", horses losing in the "Carrera de 5a serie" within six months of consecutive racing are lowered to this class. The initial weight carried then is 120 pounds, a reduction of two pounds on their load being made each time they lose until a minimum weight of 110 pounds is reached. The weight is raised to 120 pounds any time that an animal carrying less than this load wins first place in the race.

f. g. h. and i. *Carreras de 4a, 3a, 2a, and 1a serie.* Promotion of horses from "Carrera de 4a serie" to the Carrera de 3a serie" and so on with each class to the "Carrera de 1a serie" follows, as to the number of winnings required as well as to weight regulations, the manner of raising horses from the "Carrera de 5a serie" to the "Carrera de 4a serie". Likewise, the same rules are followed in lowering the class of a horse from one "serie" to another, as in the case of horses demoted from the "Carrera de 5a serie" to "Carrera de perdigones de 5a serie". The increase or decrease on the load of winners and losers is the same as in the "Carrera de 5a serie". In the "Carrera de 1a serie", however, the amount of weight that horses are made to carry is increased by two pounds each time they win, there being no limit as to the weight they may carry. Hence, many animals in this class contract tendonitis, sesamoiditis, carpalis, ringbone, navicular disease, or splints as a result of carrying excessive weight. The maximum weight carried by a horse in the Manila Jockey Club was 171 pounds by Asia, a grade Arabian, in 1923.

Very few native horses can classify in the "Carreras de 3a, 2a, and 1a serie", but the few that are able to run in these classes are among the best performers on the race track.

As novice races for grades are not always provided, grades accepted for racing are usually entered in the "Carrera de 1a serie" and are started with a load of 150 pounds. Therefore, the best of the natives compete with the grades in this class, while poorer grades that are demoted to the "Carrera de 2a, 3a, 4a, 5a, and perdigones de 5a serie" also compete with the natives in those classes. Grades are classed in the "series" named last by demotion only.

The determining factor distinguishing the native horses from the grades is generally their height. That is, all horses measuring 53 inches or lower are classified as natives, and those of higher measurements as grades.

However, if the officials of the Manila Jockey Club judge that a horse, by its appearance or pedigree, is a grade it is classified as such, notwithstanding that its classification by height is to the contrary. Also, before a horse can be admitted into any class the animal must be at least three and a half years of age as indicated by the appearance of the first two pairs of permanent incisors.

It was, however, found in the course of this study that horse owners may force the admission of grades as natives in a number of ways. In case the controversy hinges on slight differences and doubtful opinions, an animal rejected as grade may still be admitted as native if sponsored by an influential person. If an animal is over 53 inches in height, shrewd dishonest horsemen resort to administering opium to the animal which makes it roach its back and thus measure lower on its withers than it naturally would. Likewise, it is a frequent practice to pare the soles of the front hoofs unduly, so that the height of the horse may be reduced.

During the early days of racing, as in the "Carrera de velocidad", "Carrera de Luzon", etc., the owners rode their own horses. But at present the jockeys are generally hired men who are paid twenty per cent of the cash winnings.

Distances of races

The distances run range from $1/2$ to 2 miles, the graduations between these being $9/16$, $5/8$, $3/4$, $13/16$, $7/8$, 1, $1-1/8$, $1-1/4$, and $1-1/2$. These distances apply to all classes of racing. There are animals that are better for long distances than for short, and vice versa.

Purses

A sample of the purses offered to winners in the different classes of races is given below. The purses vary somewhat in amount from time to time. As a rule, the larger purses are offered in the novice classes in order to encourage the acquisition of new horses, and in the "1a serie" because the best horses run in this class. Conversely, the lowest purses are offered to the loser classes.

	<i>1st place</i>	<i>2nd place</i>	<i>3rd place</i>
Carrera de novatos nativos.....	P300.00	P90.00	P30.00
Carrera de novatos mestizos.....	330.00	90.00	30.00
Carrera de perdigones nativos.....	180.00	90.00	30.00
Carrera de perdigones mestizos.....	210.00	90.00	30.00
Carrera de vencedores de novatos nativos.....	200.00	85.00	30.00
Carrera de vencedores novatos mestizos.....	210.00	90.00	30.00
Carrera de perdigones de 5a serie.....	180.00	60.00	30.00
Carrera de 5a serie.....	230.00	60.00	30.00
Carrera de 4a serie.....	250.00	60.00	30.00
Carrera de 3a serie.....	265.00	70.00	30.00
Carrera de 2a serie.....	265.00	70.00	30.00
Carrera de 1a serie.....	300.00	90.00	30.00

Formerly loving cups were offered instead of purses. Some of the cups were: La Copa de Uli Uli, de Filipinas, Disputado, del Ejercito, de Madrid, de Forasteros, del Derby, de Santa Ana, etc.

Winners

The different provinces and countries contributing to the supply of first purse winning horses in the Manila Jockey Club have been discussed under "origin".

Table 1 shows some of the picked performers. It may be seen that many of these animals came from the province of Batangas, particularly from the municipality of Lipa. With horses whose pedigree is definitely known, Bedr. Jr., a half-breed Arabian, and Zakarrah, a pure-breed Arabian, apparently gave more select performers than other sires.

Horses classified as natives that have run in the "Carrera de la serie" and have made good records are:

Name of horses	Performance		
	Load <i>lbs.</i>	Distance <i>miles</i>	Time <i>min.</i>
Orlando.....	155	1-1/4	2:44-4/5
Borrasca.....	118	1	2:11-2/5
Adelante.....	113	3/4	1:36
Electrico.....	110	3/4	1:36
Minino.....	110	3/4	1:36
Punay.....	110	1/2	:59
Punay.....	124	9/16	1:10
Minerva.....	110	1/2	:59
Rik.....	118	9/16	1:05
Rik.....	118	1-1/8	2:27
Leyte.....	123	5/8	1:17
Recta.....	138	9/16	1:11
Oriental.....	114	1	2:06
Rush.....	140	9/16	1:05
Rush.....	126	1	2:05
Sagunto.....	130	9/16	1:05
Sagunto.....	123	1	2:05
Sagunto.....	118	1-1/4	2:40
Bleriot.....	135	1/2	:58
Bleriot.....	148	9/16	1:07
Antibarry.....	126	9/16	1:06
Antibarry.....	113	1-1/8	2:17
Apollo.....	123	1/2	:58
Apollo.....	117	1	2:05
Precioso.....	114	7/8	1:53
Precioso.....	118	13/16	1:40
Buquil.....	115	9/16	1:09
Tecumseh.....	125	5/8	1:16
Tecumseh.....	120	1-1/8	2:25
Handsome.....	130	1	2:05
Handsome.....	120	1	2:04

Feeding and management

Eighteen stables in which a total number of 143 horses were kept were investigated in this study in connection with the feeding and management of race horses. The number of animals in each ranged from 4 to 19, giving an average of 8 horses (see table 3).

Feeding

In all stables, except stable No. 3, horses were fed twice a day, morning and afternoon. The common feeding time in the morning was between eight and nine o'clock and in the afternoon between four and five o'clock. In stable No. 3, the horses were fed three times a day, morning, afternoon, and night. The morning and afternoon feeding times were the same as in other stables but at night the last part of the ration was supplied to the animals at about eight o'clock. In this stable the ration was distributed as follows: one-half in the morning, one-fourth in the afternoon, and one-fourth at night.

Concentrates

As may be seen in table 4, different mixtures of grains were used in feeding the horses. It will be noted that all the combinations include a portion of Australian fodder which is a roughage (mostly oat hay), the amount of this ranging from four-twenty-fifths to eight-seventeenths of the mixture by volume. The mixture used differed in all the stables, except in stables Nos. 2 and 6 in which the same combination was fed to the animals. Six mixtures were found to differ both in quantity and quality of constituents composing them. The most common combination consisted of rough rice, oats, corn, and Australian fodder in varying proportions. Besides these, Indian oats, rice bran, garbanzos, or chick pea (*Cicer arietinum*) were introduced in some mixtures.

The amount of concentrates given to horses in the morning varied from an average of 1.00 to 3.4 kilograms, with a general average of 1.6 kilograms. In the afternoon the amount varied from an average of 1.4 to 4.9 kilograms, with a general average of 2.6 kilograms. The total concentrates given during the day amounted to an average of from 2.8 to 7.6 kilograms and a general average of 5.2 kilograms.

Roughage

Besides Australian fodder which the animals got in the concentrate mixtures, they were also supplied green grass, using only barit (*Leersia hexandra* Siv.) for this. The green grass was given to the animals after feeding them with concentrates. The amount of this varied from an average of 0.14 to 1.64 kilograms, with a general average of 0.47 kilograms in the morning, and from an average of 0.24 to 2.0 kilograms, with a general average of .85 kilogram in the afternoon. The total amount supplied during the

day ranged from an average of 0.38 to 3.3 kilograms, with a general average of 1.41 kilograms.

The writer observed that in point of condition for racing, stable No. 8 had the best animals. That is, the horses were medium in flesh, giving the appearance of being energetic and active, free from flabbiness or sluggishness, and of sufficient form to carry the animal through strenuous effort.

It will be observed that more green grass was given to horses in stable No. 16 than in any other stable, amounting to an average of 3.3 kilograms a day. The manager of this stable claims that by supplying his animals with a more liberal amount of succulence, digestive troubles were less likely to occur.

Watering

The system of watering horses was uniform in all the stables. The animals were watered at the same time that the concentrates were supplied to them. Molasses was invariably used, enough of it being stirred in water to sweeten it. Rice bran was added to form a milky solution. The buckets containing the mixture were placed beside the feed boxes and left there till the next feeding. In this way, the animals were encouraged to drink at any time they chose. In fact, the horses drank more water than they would ordinarily do because of the molasses and rice bran in it.

Stable No. 12 added some muriatic acid (hydrochloric acid) and calcium phosphate to the drinking water each watering time at certain periods. The avowed object of the calcium phosphate was to prevent the onset of osteoporosis; and of the muriatic acid to aid digestion. The same stable sometimes gave, as a tonic, "Alquitrán de Guyot", a tar preparation, to the horses. Another specific used was "Elixir de hierro, quinina y estricnina" which was given every 15 days as a tonic in stables Nos. 1 and 16.

The horses were not given salt in any stable investigated.

Cleaning

The race horses received a general brushing before saddling preparatory to training. After training they were cleaned with the currycomb and brush. The most thorough grooming took place in the afternoon before the animals went to rest.

Each time that a horse was groomed the feet were gone over. The dirt was removed and some kind of oil was applied on the hoof once a day.

Clipping and trimming

The mane, fetlock and long hair behind the cannon bones and sometimes the foretop were always kept closely clipped, while the length of the tail was kept even with the hock or higher. The hair of the coronet was also kept short. For the tail and coronet a pair of scissors was used, and the hand clipper for general clipping.

Shoeing

A special type of shoe was used and shoeing was generally done once a month. The usual rate for shoeing was ₱4 for four feet, including the cost of shoes.

Exercising and training

Every horse is generally ridden out on the track in the morning for exercise and training, the length of time depending on the individual requirements of the animal. The usual gait the horse is made to go is the canter but when the races are nearing they are tried on short distances on the gallop, at greater speed. But they are seldom made to run at the rate they are expected to make in actual racing as rival owners are always on the lookout, timing animals in the try outs.

Green horses from the provinces are not subjected to strenuous training until after they have been hardened sufficiently to be able to withstand hard work. At first the training is light, gradually being made harder and harder.

Housing

The horses are generally housed under specially constructed sheds, but in two of the stables investigated the boxstalls were on the ground floor of the manager's residence. In all cases, the grooms' quarters were located in some corner of the stable.

All the animals were kept in boxstalls, each being 2.5×2.5 meters in floor space, excepting in stable No. 18 in which, besides boxstalls of the size just mentioned, there were smaller ones, 2.0×2.5 meters. The construction material in every case was wood. Each boxstall was equipped with grain boxes which served for roughage also. To facilitate feeding and watering, windows were constructed in front of the grain boxes. Ventilation was afforded by large openings between the boards on the upper part of the walls of boxstalls. The floor was of dirt except in stable No. 12 which was of boards. In all cases, a thick layer of sawdust was placed inside for bedding.

Grooms

According to table 5, the average number of grooms in the different establishments studied was two men. Six stables had one man each while two stables had four men each. The cash wages of the grooms varied from ₱12 to ₱40 monthly, the average being ₱30.03. The grooms of stable No. 12 received ₱12 a month, with a special food allowance. Those of stable No. 15 received ₱20 a month with food.

Boarder's rate

Out of 19 stables observed, only six establishments admitted horse boarders for feeding and management (see table 5). The rate charged ranged from ₱35 to ₱45 a month, making the average ₱40.

SUMMARY

1. The records of 324 horses, all having won first purses were studied. Two of these horses were from China, four from Arabia, and four from Australia. Of the 324, four were females.
2. Batangas, Camarines provinces, Cebu, Cavite, Negros provinces, Misamis, Pampanga, and Bulacan lead in supplying the Manila Jockey Club with race horses. Batangas registers about four times the number originating from the Camarines provinces, which rank second.
3. Among the native horses, the common colors were bay, gray, buckskin, and roan; bay horses being most numerous. With the imported horses bay is the most common color.
4. The average height of native horses was 50.9 inches and of the foreign horses, 55 inches.
5. The basis for distinguishing native horses from grades was mainly the height of an animal. Horses measuring 53 inches or below were admitted as natives while those of higher measurements were classified as grades.
6. The functions of the Manila Jockey Club are given.
7. A classification of present day races and the regulations governing them are given.
8. The distances run by horses include $1/2$, $9/16$, $5/8$, $3/4$, $13/16$, $7/8$, 1, $1-1/8$, $1-1/4$, $1-1/2$, 2 miles.
9. The performances of select winners are given.
10. In the early days cups were given instead of purses to winners. Today, purses are awarded.
11. Bedr Jr., a half-breed Arabian, and Zakarraah, a pure-breed Arabian, were notable as producing more famous race horses than other sires listed.
12. Eighteen stables and 143 horses were investigated in connection with the feeding and management of race horses.
13. Race horses are fed generally twice a day.
14. Different concentrate mixtures used are given, the most common ingredients in each mixture being: oats, rough rice, Australian fodder, and corn.
15. The average grain consumption daily is 4.2 kilograms.
16. Besides Australian fodder mixed in the grain mixtures, green *barit* grass is given. The daily average consumption of green grass is 1.3 kilograms.
17. Watering is done generally twice a day. Molasses and rice bran are usually added to the water to encourage the animals to drink more and to promote their health and condition.
18. Grooming is done twice a day and more thoroughly than in the case of carromata horses.

19. The mane and sometimes the foretop were observed to be closely trimmed. The tail was found to be usually cut to about the level of the hocks.

20. Race horses are regularly shod with specially made shoes.

21. Race horses are exercised and trained the morning daily.

22. All horses were kept in boxstalls constructed with dirt floor. Sawdust was used in all cases as bedding.

23. The average number of grooms in each stable was two. The average wage of grooms was ₱30.03.

24. The average rate for the feeding, care, exercising, and training of a horse boarder was ₱40.

RECOMMENDATIONS

From the foregoing study, the following recommendations are presented:

1. Realizing the difficulty of basing a just classification of race horses seeking admission to the race track into natives and grades, on appearances alone, it is recommended that the determining factor be height alone.

2. That the height regulation for native horses be raised whenever the number of such animals available warrant such action. This regulation will react favorably towards the breeding of larger horses.

3. The Manila Jockey Club, being the main beneficiary of improved horse breeding operations, should set aside a certain sum from its earnings to promote the breeding of better horses.

4. One way in which the Manila Jockey Club may help produce superior horses is by acquiring retired race horses with good records and individuality and transferring them to government entities or other reliable enterprises engaged in horse breeding activities for use as stud horses.

5. The practice followed by one horseman in supplying more succulence or green grass to race horses to avoid digestive troubles is salutary. Very many race horses at present suffer from digestive disturbances as a result of too much concentrates in feeding.

6. Improvement in the construction of boxstalls should be directed towards providing for more ventilation and light, leading to more sanitary conditions. Horses are not as likely to develop vices in well constructed boxstalls.

TABLE 1

Showing some of the best performers run under the auspices of the Manila Jockey Club

NAME OF HORSE	YEAR	KIND OF RACE	PERFORMANCE		
			distance, mile	load, lbs.	time
Cambing.....	1877		1/2	—	1:00
Liautard.....	1880		3/4	—	1:41
Silver.....	1891		1-1/2	130	3:10
Bob.....	1898		7/8	140	1:54-1/2
Girafa.....	1899		3/4	150	1:41
Orlando.....	1902	1a serie	1-1/4	155	2:44-4/5
Gloria.....	1902	1a serie	1	129	2:16
Matulin.....	1902	1a serie	1	136	2:14
Borrasca.....	1905	1a serie	1	118	2:11-2/5
Adelante.....	1906	1a serie	3/4	113	1:36
Eléctrico.....	1907	1a serie	3/4	110	1:36
Mínino.....	1908	1a serie	3/4	110	1:36
Visayas.....	1910	1a serie	1/2	122	1:01-1/5
Punay.....	1916	5a serie	1/2	110	:59
Punay.....	1917	1a serie	9/16	124	1:10
Minerva.....	1917	3a serie	1/2	110	:59
Rik.....	1919	4a serie	9/16	118	1:05
Rik.....	1919	1a serie	1-1/8	118	2:27
Leyte.....	1919	1a serie	5/8	123	1:17
Recta.....	1920	1a serie	9/16	138	1:11
Oriental.....	1920	3a serie	1	114	2:06
Rush.....	1924	1a serie	9/16	140	1:05
Rush.....	1924	1a serie	1	126	2:05
Sagunto.....	1922	3a serie	9/16	130	1:05
Sagunto.....	1923	1a serie	1	123	2:05
Sagunto.....	1925	1a serie	1-1/4	118	2:40
Doctor.....	1923	3a serie	1	111	2:09
Bleriot.....	1923	1a serie	1/2	135	:58
Bleriot.....	1924	1a serie	9/16	148	1:07
Pacific.....	1923	4a serie	1-1/2	110	3:14
Asia.....	1923	1a serie	5/8	168	1:17
Asia.....	1923	1a serie	7/8	150	1:54
Asia.....	1923	1a serie	1/2	171	1:02
Kuta.....	1924	4a serie	7/8	118	1:54
The Piker.....	1924	1a serie	1/2	119	:57
Barato.....	1924	3a serie	5/8	112	1:17
Antibary.....	1924	1a serie	9/16	126	1:06
Antibary.....	1924	1a serie	1-1/8	113	2:17
Apollo.....	1924	3a serie	1/2	123	:58
Apollo.....	1924	3a serie	1	117	2:05
Judith.....	1925	5a serie	1	120	2:10
Judith.....	1925	2a serie	9/16	112	1:08
Precioso.....	1924	5a serie	7/8		
Precioso.....	1925	1a serie	13/16	118	1:40
Shucix.....	1925	4a serie	5/8	112	1:18
Buquil.....	1925	2a serie	9/16	115	1:09
Tecumseh.....	1925	1a serie	5/8	125	1:16
Tecumseh.....	1925	1a serie	1-1/8	120	2:25
Handsome.....	1925	1a serie	1	130	2:05
Handsome.....	1925	1a serie	1	120	2:04
Black Beauty.....	1926	1a serie	1/2	141	:58
Black Beauty.....	1926	1a serie	1	135	2:02
Otello.....	1926	4a serie	5/8	119	1:16
Otello.....	1926	3a serie	1/2	121	1:01

TABLE 2
Showing frequency distribution of height

HEIGHT	NUMBER OF HORSES			
	Philippines		Foreign countries	
<i>inches</i>	<i>number</i>	<i>per cent</i>	<i>number</i>	<i>per cent</i>
48	10	3.5	0	0
49	32	11.3	0	0
50	63	22.3	0	0
51	112	39.7	0	0
52	24	8.5	2	22.2
53	30	10.6	0	0
54	10	3.5	1	11.1
55	1	0.3	1	11.1
56	0	0	1	11.1
57	0	0	3	33.3
58	0	0	0	0
59	0	0	0	0
60	0	0	1	11.1
Unknown	(32)	—	(1)	—
Totals	282	99.7	9	99.9
Mean height		50.9 in.		55.5 in.

TABLE 3
Showing the number of horses, boarder's rate, and the number and wage of grooms in different stables

STABLE NO.	NUMBER OF HORSES	BOARDER'S RATE	GROOMS	
			Number	Wage
		<i>pesos</i>		<i>pesos</i>
1	8	—	2	60.00
2	8	45.00	2	80.00
3	11	—	4	160.00
4	6	—	1	40.00
5	6	—	1	25.00
6	7	—	2	60.00
7	6	—	2	60.00
8	4	45.00	1	35.00
9	7	35.00	1	30.00
10	9	—	3	90.00
11 ^a	19	40.00	4	135.00
11				
12	6	—	3	36.00
13	13	40.00	2	60.00
14 ^a	6	35.00	1	—
15	4	—	1	20.00
16	8	—	2	65.00
17	8	—	2	60.00
18	7	—	2	65.00
Total	143	240.00	36	1,081.00
average	8	40.00	2	30.03

^a The owner of this stable is the manager and at the same time the jockey and the groom.

TABLE 4

Showing concentrate mixtures and average feed consumption by each horse in different stables

STABLE NO.	CONCENTRATED MIXTURES	FEED CONSUMPTION					
		Concentrates			Roughage		
		a. m.	p. m.	Total	a. m.	p. m.	Total
		kgm.	kgm.	kgm.	kgm.	kgm.	kgm.
1	Palay.....3 parts ^a)						
	Rice bran.....1 ")						
	Oats.....2 $\frac{1}{4}$ ")	3.38	3.50	6.88	0.52	0.96	1.48
	Australian fodder.....1 $\frac{3}{4}$ ")						
2	Oats.....1 part)						
	Palay.....1 ")	1.40	2.68	4.08	0.50	0.72	1.22
	Australian fodder.....1 ")						
3	Rice bran.....1 part)						
	Oats.....2 ")						
	Palay.....2 ")	1.10	2.30	3.40	0.14	0.24	0.38
	Australian fodder.....2 ")						
	Corn.....1 ")						

COCONUT CULTURE IN BALBAGON ISLAND, CARLES, ILOILO¹

AMADO A. ANDRADA

WITH TWO TEXT FIGURES

On December 27, 1926, I went to Balbagon with Mr. Marcial Aclaro, the son of Don Eugenio Aclaro of Estancia, Iloilo. The purpose of my visit was to see the actual culture of coconut on what is said to be one of the best new plantations in my home town, Carles, Iloilo. I was then to write a report on the plantation as part of my work in Agronomy 16 in the College of Agriculture.

Balbagon is an island situated between the islands of Gigantes and the island of Panay. The shores of this island are steep, consequently the water near it is deep. Steamships going to Manila pass by this island so close that the rows of the coconuts in the plantation can be clearly seen.

In the early days of American administration in the Philippines this small island was owned by three persons who still reside on it. They tried to raise coconuts but failed three times. The most important cause for the failure was the lack of capital to maintain a clean plantation and to remove trash that makes good breeding places for the coconut beetles.

It was in 1920 that a rich merchant from Estancia, Don Eugenio Aclaro, landed on Balbagon Island and was impressed by the possibility of making a splendid coconut plantation on it, if only enough precaution could be taken against the coconut beetles. He sought for the owners and asked them to sell the whole island to him. Being very poor, they agreed to do this and in October, 1921, the island became the property of Don Eugenio. He was very ambitious to make a good plantation so he made his plans before he began work. He sent additional laborers to the island and furnished housing for them.

SOIL AND CLIMATE

According to many old experienced farmers, sandy loam soil is the best soil for coconuts especially when it is located by the seashore. This island has this type of soil and of course all the land is near the sea. These conditions make an ideal place for coconut production.

Upon examining the soil, I found shells and sand mixed to a depth of about three to four meters. From this evidence I concluded that this island is of marine origin.

¹A paper presented in partial fulfillment of the requirements in Agronomy 16 (Coconut and other Oil Plants).

The soil, as a whole, is sandy loam and it is very uniform throughout the island. The surface soil is about twenty-five to thirty centimeters deep. The color is brown at the surface and dark brown just below with some whitish gravel and shells. The soil is not stony, but loose and easy to cultivate. This condition of soil denotes excellent aëration, a soil quality needed by coconuts.

The subsoil is whitish in color and contains very little organic matter. It is a mixture of sand and gravel. If the surface soil were removed, I do not believe crops could grow in the subsoil for there is no sign of fertility. No hard tuff is seen even if the soil is dug four meters deep.

The water table of this soil is about three meters deep. This gives allowance for good aëration. Water can be seen by digging to a depth of three meters. According to the residents on this island, the water follows the tide of the sea. When the tide is high the water in the wells is deep. Although the land is so level that there is no standing water from higher elevation, the water is not salty. It is good drinking water even during the longest dry season. As to why in such a narrow island the water is fresh throughout the year, even during the longest dry season, is hard to explain. This island is about three meters above the sea level.

In rainfall the island is similar to northern Panay. The dry season is only two or three months long. The rainy season is longer but the rain is not very heavy. The wind blows almost all the time. As there are few typhoons in the western Visayan Islands there is little danger in this island from such storms. So far no damage has been done to this plantation by typhoons.

METHOD FOLLOWED IN ESTABLISHING THE PLANTATION

Don Eugenio ordered his tenants in Estancia to select coconut seeds for him to use on this island plantation. Three thousand nuts for seedlings were sent after rough selection was made directly on the trees. The basis of selection was prolificacy and size of the nuts of the mother plants. Only well-matured nuts were used.

While seed selection was going on in Estancia, cleaning was proceeding on the small island. The laborers were paid on contract basis and on daily wages basis, ranging from seventy centavos to one peso a day.

The heaviest work in clearing was cutting down the trees and digging up the stumps. Practically all the trees were cut down and the roots were dug up and burned so as to remove possible breeding places for coconut beetles. Then the field was plowed and planted to corn on May 1, 1922.

On May 15, 1922, the three thousand seedlings were planted by the tenants on lots assigned to them on fifty-fifty share basis. That is, after planting, the tenant was to take care of the plantation. He might plant other crops of his own, provided the crops did not hinder the growth of coconuts.

When the coconuts become about ready to bear fruit, Don Eugenio will pay one peso to the tenant, for each coconut tree on his share. The tenants were given carabaos and are obliged to plow their lots in the plantation twice a year at regular intervals.

The tenants planted the trees at a distance of five *dupa*, or approximately nine meters apart. This distance is ideal for this plantation because there is a tendency for the plants to grow large leaves as they are larger in size than ordinary young coconuts of the same age in the College plantations.

Generally, each lot is cultivated twice a year, but some lots where catch crops are planted, are given more cultivation. The tenants plant camote, corn, onions, *cadios*, various legumes, ube, water melons, and other edible crops between the young trees. They even plant catch crops between the three year old coconut trees. (See fig. 1.) These vegetable crops are consumed by the tenants themselves, but if there is a surplus it is sold in Estancia where they sell the surplus fish they catch in the sea.



Fig. 1.—Showing camote planted as catch crop between three-year old coconut trees.

In the year 1923, another three thousand seedlings were planted on the island. As the soil is loose and sandy, the method they used in planting is very simple. A heavy hoe was used for digging and the seedlings were planted and covered as usual, only the rows were carefully lined and were made as straight as possible. Sticks were placed before holing to locate the places the holes were to be dug. The trees were planted in squares.

In May, 1924, four thousand more seedlings were planted, some of which were used in replanting where seedlings had died in the previously planted fields. With the 1924 planting, coconut seedlings completely covered

the island. My estimate was that 9,500 trees out of 10,000 seedlings planted were still growing. In the part of the island where many trees died, owing to neglect and drought, the trees are not uniform as there is a mixture of small and large trees of different ages. Some coconut seedlings had died from neglect and others from the effect of the dry season.

PLANTATION LABOR

After buying the island, Don Eugenio increased the number of families in the island to fifteen, but only ten of these are tenants. The three former owners of the island are among the tenants and planted coconuts on the share basis as other tenants did. The five families that are not tenants are laborers working for daily wages. They do not have a share in the coconut plantation. After the trees were planted the tenant families worked on their lots without pay except what they got from their catch crops. The laborers composing the five families who work for wages make piles of stones around the island to prevent erosion by the waves.

In the months favorable for fishing, the tenants, as well as the laborers, fish and sell dried and salted fish in Estancia where they buy some of their clothing and food supplies.

Sometimes when group labor is needed, as in the planting of camote, all work together, thus making the work easy. A condition which is not found in many places is the absence of money for use in exchange for their local products. Any one can ask and receive without pay from another person any kind of product that is raised on the island. Buying and selling are practiced only in the sale of fish and purchase of rice, clothing, and other necessities in Estancia.

CONTROL OF PEST AND DISEASES

From my observation, I found no coconut trees attacked with any disease which is very harmful. Some trees, of course, are infested by coconut beetles, but not to a great extent because the tenants are rigid in the control. So far, coconut beetle is the only pest that attacks the plantation. This pest is one of the most important causes for the failures of previous attempts to grow coconuts in the island. It was the cutting down of all forest trees and burning them that helped much in the control of this pest. The owner pays five centavos for any larva, pupa, or adult coconut beetle caught on the island. According to Don Eugenio, there was a time when a woman, alone, could earn as much as twelve pesos a day in collecting coconut beetles. He said he spent about eight hundred pesos in the buying of the beetles alone. But now he is confident that only a very few beetles can be found in his island. There is no possibility of reinfestation for the neighboring islands are about eight kilometers away, which is too far for the beetles to fly.

PERSONAL IMPRESSIONS

I found it well worth while visiting this island. I observed the life of the people who are simple in their environment and character. They are

industrious and lovable. They do their work willingly, honestly, and faithfully. Their greatest aim is to make their plantation successful by following faithfully any instruction from the owner.

Through the help of these contented workers, everything on this island that the owner wishes to be done is done. The wise way the laborers are handled is one of the secrets of the success of this plantation. I noticed this when I visited this place, for the son of the owner, Mr. Marcial Aclaro, my companion and I were treated in the most hospitable way and in return we showed our appreciation of their courtesy. The people were proud to show to their master their work and their satisfaction was evident. From this I learned that the way employees and tenants are dealt with does much to determine the kind of service they give in return. I learned that these people often give greater amount of service to the master than their master pays them for. So much for the discussion of the plantation itself.

Some people speak of the Tayabas coconut as the most superior coconut tree, the same is said of Zamboanga trees, but I can say that Balbagon trees may be in line with these, if not even better in quality.

In figure 2 the size of the trunk of a four-year old tree can be seen. This tree will probably bear fruit in its fifth year. The trees are very green, showing that they are vigorous, not stunted. The luxuriant foliage which the plants possess denotes their capacity for manufacturing food for a rapid growth.

In all his coconut plantations, including Balbagon, Don Eugenio has about 12,000 trees which are bearing and about 19,500 trees which are about to bear. He said most of these trees had been planted under his direction and observation, so that he knows the actual condition of all his plantations. He told me that of all his plantations, Balbagon, which has only about 9,500 trees, may surpass all the others in production when bearing time comes, for there the trees are very vigorous and well cared for. Besides, the island is isolated, and it is almost free from pests and diseases.



Fig. 2.—A typical four-year old coconut tree in the plantation. Note the size of trunk.

NOTE: AN ENTOMOLOGICAL SURVEY OF THE PACIFIC

(Reprinted from *Science*, June 10, 1927.)

The conditions on many of the islands of the Pacific are rapidly changing. Mountains which were formerly covered by native forests are being denuded, or the original vegetation is being replaced by introduced species. With the changing conditions in plant life and the increase of commerce there are accompanying changes in the insect fauna. If entomologists are ever to know the insects of the Pacific area no time can be lost. It would be difficult to over-estimate the importance of a thorough knowledge of the native insects of this region either from a purely scientific or an economic point of view.

An entomological survey of the Pacific is being planned by a group in Hawaii. The Bishop Museum and the Hawaiian Sugar Planters Association have each pledged financial support over a period of five years, and it is likely that the Association of Hawaiian Pineapple Cannery will join with them. A local committee has been organized with Dr. C. M. Cooke, of the Bishop Museum, as chairman, assisted by John E. Russel, chairman of the experiment station committee of the Hawaiian Sugar Planters Association, Charles R. Hemenway, chairman of the board of regents of the University of Hawaii, Charles S. Judd, executive officer of the Board of Agriculture and Forestry, and A. L. Dean, director of the Experiment Station of the Association of Hawaiian Pineapple Cannery. This committee, no one of whom is an entomologist, has secured Dr. C. F. Baker, dean of the Agricultural College of the University of the Philippines, to be the scientific head of the survey. Dr. Baker will have his headquarters in Honolulu. The present plans contemplate one or more field parties which will send all collections to Honolulu where some material will doubtless be identified, but much of it will be sorted and sent to the specialists to work up. According to the present plan Dr. Baker will devote all his time during the first year to the work of the survey, and in subsequent years divide his time between that and the University of Hawaii.

A. L. DEAN.

ABSTRACT

Tenancy on rice holdings in the municipality of San Felipe, province of Zambales. JUAN PRONTO. (*Thesis presented for graduation, 1924, from the College of Agriculture No. 257; Experiment Station contribution No. 464*).—The survey was conducted in the field in the municipality of San Felipe, Zambales, in the early part of 1923. The “survey” method was used. One hundred representative holdings in different parts of the municipality were selected. Several landlords, but tenants for the most part, were interviewed in the collection of data. Results were divided into economic and social phases.

Results of the economic survey.

1. The average area to a tenancy in San Felipe, Zambales, is 1.96 hectares, of which 97 per cent is under cultivation for rice. Crop rotation is not practiced. The 100 holdings are divided into 306 parcels.

2. The average length of tenure is 5.5 years, a short period in which to make permanent improvements on the land.

3. Eighteen per cent of the tenants hold double tenancies, showing a desire for wider area. Forty-two per cent of the tenants have always been tenants, the remaining 58 per cent had followed, formerly, occupations of various kinds.

4. The terms of the majority of contracts are: The division of the crop based on the valuation of one-third for labor, one-third for work animal, and one-third for land.

5. The tenant's investment on capital goods averages ₱259.92, or ₱142.41 a hectare.

6. The tenant spends an average of 1287 hours of labor each year, of which 1089 are devoted to agriculture and 198 to secondary occupations. He spends 1013 hours on his tenancy or 519 hours a hectare. The total average animal labor used is 385 hours, or 196 hours per hectare.

7. The gross income, including secondary and household industries, of each tenant averages ₱204.43 which is hardly enough to support a family of 5.35 persons. The average agricultural income is ₱153.08 per tenant. The tenant works on his tenancy for his labor wage only.

8. The tenant gets more per hour wage from secondary occupations than from agricultural labor.

9. Thirty-three out of the 100 tenancies received advances from the landlords in form of palay, the value ranging from one to twenty pesos. The rate of interest when computed ranges from 12 to 33 per cent.

10. Only 13 per cent of the tenants surveyed own land, the average for each tenant is 0.95 hectare, or an average of .124 hectare for the entire survey. It will take, therefore, 85.2 years for each tenant to become owner of the land equal to his present holding.

Results of the social survey.

1. The tenants are all male, with an average age of 44.7 years, and have been married, although ten are widowers. The average age at marriage of male is 20.62 and 19.17 years for females.

2. There seems to exist a tenant class in the regions surveyed although their number is not considerable. The percentage of stability is 71.

3. There is practically no blood relationship between landlords and tenants.

4. The average size of the family for the region surveyed is 5.35 persons. The percentage of mortality of children born is 35.

5. The majority of houses and yards were kept fairly clean. Toilet facilities are very poor.

6. The general literacy for the entire region is 56.38.

7. Cockfighting is not popular in the region.

8. Informal co-operation in economic and social life of the tenants exists.

9. The political right of the tenants is not controlled by the landlords. The tenants however exert but little influence in the community. Fifty-nine of the one hundred tenants are electors.

10. There is a general desire for the acquisition of homesteads but the tenants lack the information and facilities for getting them.

*Abstract by Francisco M. Sacay
Of the Department of Rural
Economics.*

A wise man knows an ignorant one, because he has been ignorant himself, but the ignorant cannot recognize the wise, because he has never been wise.—*Persian Proverb.*

EXTENSION DIVISION NOTES

Personal Management vs. Absentee Landlord

Pantaleon Bautista, B. S. '18, may be called an example of modesty. While he was in College he never made mention of his family's wealth. He was simple in every way, in dress as well as in living, and in his whole deportment towards his fellow students. The only difference that singled him out from most of his companions in College was that he was older, having at home a wife and children. Also, that he was among the few who came to College with a definite life object in view. His agricultural education was to fit him to develop a hog industry. Since leaving College Mr. Bautista has not sought publicity or popularity any more than when a student.

Only about two months ago two professors of the College of Agriculture discovered what Mr. Bautista has been doing since graduation, as a part of his contribution to the commonwealth. Looking for a co-operator in a study of life history and habits of bangos, *Chanos chanos* Chanidae, being undertaken by the Department of Zoölogy and Economic Entomology the two professors called at the residence of Mr. Bautista's parents in Malabon, Rizal. They not only secured the desired co-operation and an ample supply of fish samples from the extensive fishponds of the Bautista family, but were told of Mr. Bautista's work for the past nine years.

Being an only child, he might well have followed the time-honored custom of living with his family in the paternal home which is a large house with all modern conveniences. Here a life of ease and comfort, light work under the direction of his father was waiting for him. But he chose to make his own life.

He went to Orani, Bataan, and assumed personal management of the family sugar and rice farm. Here he began to carry out his plan of student years, hog production. He went about this work in the following manner:

Accompanied by a man thoroughly familiar with local conditions he went to Jala-jala, Rizal, and carefully selected his foundation stock. He secured eight of the best Jala-jala sows he could find, and one of the best Berkshire boars he could get at the Alabang Breeding Station of the Bureau of Agriculture. This stock including all transportation expenses costs him ₱200. On his farm, simple bamboo and nipa sheds with suitable compartments, stalls, and pasture lots, concentrated feed and water supply were provided. His rotation pastures were planted with camote and peanuts. He did not buy feed as he used the by-products of rice and sugar grown on the farm, supplemented with the pastures. He so trained his hogs.

that they came to their own respective stalls and compartments; did not go astray. Hence there was no difficulty in keeping them separate to note individual performances in litter production as well as in other desirable features. Mr. Bautista's aim was to produce as fast as he could the greatest number of grade pigs and place them on the market at the shortest possible intervals after they had been weaned and attained the best marketable age. Selection was carried on in accordance with his objectives. For the disposal of his output he gradually built up a market right in his home town, Malabon, where his hogs gained popularity and were sought for their tameness and excellent qualities in conformation, vigorous growth, and early maturing for the dual purpose of meat and fat production.

Though he gave most of his attention to his hog industry Mr. Bautista also directed the general work on the farm, especially that relating to sugar cane and rice, improving the methods of production and turning out products that could sell for the highest price. His farm consists of 72 hectares, of which 62 are devoted to sugar cane and the rest that is low to lowland rice. The remaining highland is used for his hogs and miscellaneous small crops. He found that it was much more profitable to sell the sugar cane juice than to make it into muscovado sugar. He sells the juice right on the farm to traveling buyers from Bataan or from Pampanga.

This cane juice is used to produce *patcohin* (small *panochas* or brown sugar of the candy consistency); *guinaockin* (sticky molasses); and *carabahin* (molasses just beginning to crystallize, used for peanut candy). For these forms of sugar, Bautista found the sugar cane variety known as *Sinanduyong na puti* to be a suitable variety.

Just as Mr. Bautista was highly optimistic about his hog industry, his father, old and overburdened with the management of the family's fishponds in Malabon and in Lubao, urged his son to run the farm at Orani as an absentee landlord and come to the family home and relieve him. So Pantaleon entrusted his hog business to the best of his tenants. While the other business on the farm practically returned to the old status, that is a farm worked by share tenants under an absentee landlord's direction and only visited by him when the harvest season comes, the hog business very soon began to decline, and soon it did not pay to go ahead with it.

Mr. Bautista said that after balancing the business, the figures showed that he made in his hog industry a net profit of ₱300 for an investment of ₱1,000 after running it for about one year and a half.

Correction of Address

Andres L. Pacis, B. Agr. '25, writes from Bayombong, Nueva Vizcaya, that his address given in the August number, THE PHILIPPINE AGRICULTURIST, should be changed to P. O. Box 25, Bayombong, Nueva Vizcaya. He further states that 60 hectares of rice land now demands his attention. He says "that for those who like to work Cagayan Valley is extensive and good enough for the display of their energy."

The Fish Pond Industry

The sources of the bangos fry sold at Malabon are Marinduque, Bauang, and San Fernando, La Union; Boac, Marinduque; Salinas, Cavite; Bucao, Zambales, and as far distant as from the island of Negros. They are usually caught in April and May. The fresher they are brought to Malabon for sale the better the price, and the surer their growth in the ponds. Strangely enough fry arriving at Malabon as late as the month of August when they have attained one inch (2.54 cm.) in length are not desirable for seed; when placed in the pond they are said to suddenly disappear leaving no trace of their existence. No explanation for this is known. All fishponds are thoroughly cleaned of injurious and harmful matter before the fresh fry are turned in. The fry are sold in earthen pots of different sizes. For example, Bauang pots usually contain 1,500 fry; Zambales pot from 3,000 to 4,000; Negros, 10,000. Customarily, large pots are sold at ₱10 each and small pots at from ₱2 to ₱3 each. The Negros pots are the cheapest, selling at ₱6 each. Since their comparative recent appearance on the Malabon fry market they have stirred up a lively competition. Experienced fishpond men readily estimate the number of fry in each container. They seldom miss by a hundred. When actual count is resorted to the buyers pick out a number of pots of uniform size that contain the least number of fry. Then the count of every lot of the same size of pots is based on the pots whose content has been counted.

In growing the fry in the nurseries, they are first put in small compartments, the size of which is dependent upon the number of fry; as they grow larger they are transferred from one compartment to another or from pond to pond of increasing size until they are large enough to be put in the final rearing pond. Their vigor of growth depends much upon the size of the pond, the amount of feed and the number of the fry. They can be kept stunted by confining them in a small compartment on a reduced amount of feed. In fact, when the supply of bangos is greater than the demand and no compartment is available in the final rearing ponds, the fry are kept undersized until prices become normal and room is available. Ordinarily, it takes a month for fry to attain a size suitable for transplanting into the final ponds where they are reared and developed to a marketable size.

At Malabon they make it a special business to produce nursery stock for sale to outlying fish-pond growers. One hectare of nursery pond may contain about 250,000 fry. Fry one month old sell for ₱5 a 10,000. Final harvests from large ponds usually occur when fish are from six to seven months old. In one man's ponds at Lubao the fish are harvested when ten months old and sold at from twenty-five to thirty centavos a piece. The fish are caught in nets. To facilitate the catching, the brackish, or sea water adjoining the ponds is let in through the pond gate. All the fish in the pond rush towards the incoming water and crowd together; then they are easily caught in nets. This process is locally called *pasuba*. This

habit of the bañgos is a source of heavy loss when the ponds are flooded by heavy rains. When the ponds overflow it invariably means a total loss to the grower of the bangos. Only crabs and shrimps and other stray fish of small consequence are left in the pond. This is the reason fishpond owners are always on the watch in caring for the dikes; in flood times an extra number of laborers is always on hand with spades and shovels ready to rush work in building up the dikes higher than the level of the flood water to prevent loss from overflowing. In fact this item is the largest of all items of expenditure in keeping up the ponds. There are other sources of damage of minor importance. Lately a small species of fish of unknown origin has made its appearance in nursery ponds and has multiplied rapidly devouring a lot of young bangos and causing a considerable amount of damage.

Fish ponds vary in size. The size depends upon the extent of the area, lay of the land and the convenience of the grower in handling. One fishpond at Lubao covers about 50 hectares and is large enough to accommodate 100,000 nursery stock that will be caught at the age of ten months. Under ordinary conditions the percentage of success from the final catch ranges from 50 to 75 per cent.

As a common practice fishponds are cleaned in the month of March for the reception of new stock. The water is drained off and the whole of the pond is exposed to the sunshine. By so doing, new voluntary growth of moss upon which the bangos feed springs up over the muddy bottom. Gradually then the brackish water from the adjoining river is let in to stimulate the vegetative growth, the submersion of the moss being gauged by the degree of its growth so as not to shut out the influence of the sunshine upon it. When luxuriant growth of the moss is obtained, the water is let in at a suitable depth for the reception of either the fry or the grown nursery stock. It was shown in the fishponds that one species of moss is allowed to develop for the fry and another for the larger fish. Presumably each specific kind of moss is obtained through careful gauging of the water allowed into the ponds at the time new growth of moss is developed.

For the maintenance of one man's seven fishponds at Lubao, Pampanga, ₱2,000 a year are spent. The owner said that as many as fifty men at ₱2 a day are employed from time to time, mainly to keep the dikes in repair and prevent damages from floods.

The running of the pond is entrusted to a manager under the supervision of the owner. The manager is usually experienced in fishpond operations. A contract is entered into between the manager and the owner on the basis of share arrangement upon the number of fish caught. Under Malabon conditions where nursery stock is raised, the share is fifty-fifty of the total produce between the manager and the owner. At Lubao, where the nursery stock is grown to a marketable size, the manager gets one-third of the harvest and the remaining two-thirds go to the fish-pond owner.

The industry of fishpond culture is pronounced at Malabon as elsewhere in the Islands to be one of the most highly profitable industries, and, like coconuts, less exacting of the owner's time and energy than many

other agricultural industries. It is a specialty undertaking, and as such and as against a diversified enterprise it has no alternatives. It requires an investment of practically the same amount as the amount lost. But under ordinary circumstances, it is said that for one year's loss it takes but the success of the next crop for the owner to recover and make a reasonable profit on the investment.

Continued Interest in the College Copra Drier and Colotcolotan sacks

Judge Felix Samson of Isabela and Messrs. Salvador Muñoz and Vicente Ramos of Camalig, Albay, came recently to visit the College and examine the structure of the new College Copra Drier. They were inquiring for a man from the College to direct the construction of a drier at the town of Camalig as a demonstration to Camalig copra producers. The expenses for the construction to be borne by them.

Messrs. Antonio Caballeros and Gregorio Arellano from Sorsogon, Sorsogon, and, also, a party of Japanese came very recently to study personally the details in construction of the copra drier. The College drier has not been repaired since it was damaged by the storm last November, so we can show only the ruins to these visitors. But they got a clearer picture of the structure by personal inspection with the help of explanation and the Circular No. 11, on the drier than by correspondence.

Mr. J. Campos, Vice President of the Campos Rueda Hermanos, Inc., in Manila, accompanied by his engineer, made a visit on the Campus for the main purpose of getting a sketch of the copra cutter which was devised by Professor Henares in conjunction with the College Copra Drier. He was anxious to buy one to be used in his coconut plantation in Palawan to save the trouble of cutting copra with a bolo and to reduce expenses; but the College is not in a position to manufacture this new device for sale. Doctor Roxas explained to them the make-up and the handling of the apparatus and allowed them to copy it and make one themselves. According to actual trials "a copra cutter of this design * * * can chop the meat from 100 nuts in 3 to 5 minutes, whereas with a bolo and for the same number of nuts a woman will require from 20 to 25 minutes."

Mr. Campos also went over the drier for the possibility of introducing it on his coconut plantation in Palawan. He was very much interested in the sacks of *Colotcolotan* fiber woven into rice and copra sacks under the direction of Dr. Vicente Aldaba of the Department of Agronomy. He took with him samples of the fabric and a specimen of the plant from which the fiber is extracted. This plant is a wild plant and is considered a troublesome weed almost everywhere. There is a lot of them in coconut plantations and in neglected places. The sack made from this fiber as woven in a crude native loom by the College fiber class is very much like the imported jute sacks from India. Many of our visitors believe the *Colotcolotan* to be stronger. The making of fiber for these sacks would make a profitable household industry, especially for our country people, and a good industrial exercise for our schools.

EXCHANGE NOTES

A few years ago, the Research Staff of the California Fruit Growers Exchange evolved a process for preparing pure orange juice, in concentrated form. The product is made from sound fruits, carefully washed and selected. The juice is expressed and immediately evaporated in glass-enamelled vacuum pans at a temperature of 98°F. The concentration reached is 7 to 1 by volume. The concentrate is run into sterilized glass jars, which are immediately closed with sterilized corks. Careful tests have shown that orange juice concentrated in this simple way retains its flavour and vitamin activity, even after storing for several months.

—*Tropical Agriculture.*

Too much water is one prime cause of tomato plants dropping their blossoms and failing to set fruit. We have many inquiries about this deficiency from those who state that the vines are large and vigorous. Too much water produces rank vegetable growth and often, when tomatoes fail to set because of lack of pollination, the cause is climatic, but when blossoms drop the cause is usually excess of water. Vigorous vines may safely be left without water at blooming time until the leaves wilt. Then irrigate.

—*Cultivator (California).*

In order to sustain our population, it was necessary to import over seventy million dollars worth of rice. Nor was Malaya the only Eastern nation that was unable to feed her population without depending upon the three main sources of supply viz. India, Siam, and French Cochin China. In 1920 China, Japan, Korea, the Philippine Islands, the Netherland East Indies, and Ceylon obtained 1,097,000 tons for this purpose. In 1925 the aggregate imports of rice to these countries had risen to 2,306,000 tons. The importers include China, whose imports of rice during that period rose from 70,000 tons to 752,000 tons. Not only are the rice imports of these nations increasing from year to year, but there is a growing tendency for them to turn to India for their supplies. This is because India alone has been able to produce and export rice to meet this increased demand. As an instance of this growing reliance on India may be cited the example of Japan which imported from Burma one ton of rice in 1920, a figure which rapidly increased to 199,832 tons in 1926.

—*The Malayan Agricultural Journal.*

For the first time since avocados began assuming an importance in Southern California agriculture, there was an overproduction this year—the crop amounting to 1,500,000 pounds more than the previous year's crop of about 500,000 pounds—and this surplus production is being successfully disposed of in the east by means of a direct mail advertising campaign directed to eastern chefs.

In this advertising the chefs of big hotels and eating places have been told about the new fruit, have been shown how to use it in salads and in other ways for the purpose of giving a novel "kick" to menus and as the result of this campaign as much of the fruit is now being sold in New York City as is being sold in Southern California. * * *

The price obtained for the crop this year is averaging between 20 and 35 cents per pound to the grower, which has brought returns averaging from \$750 to as high as \$2,000 an acre.

—*Cultivator* (California).

In 1926 United States exports of men's collars and cuffs were valued at \$570,207, of which Latin American countries took 64 per cent. The United Kingdom and its colonies were the next largest customers, having received about 19 per cent of the total exports. The Philippine Islands purchased over \$30,000 worth and comprise one of the largest individual foreign markets for American collars and cuffs.

—*Commerce Reports* (United States).

A survey covering 126 poultry ranches brooding 221,932 chicks shows the total expenses of chicks, feed, labor, depreciation, interest, fuel and litter for brooding 1,000 chicks to be almost \$105 for 1000 chicks. This leaves the net expense of brooding 1,000 chicks to three months of age at \$245.

Figuring the average mortality, about 440 pullets will remain on the ranch, making the cost per pullet of about 55 cents when they are raised from baby chicks.

—*Cultivator* (California).

There is enough nitrogen above an acre to grow 70,000,000 bushels of corn, according to Dr. F. C. Bauer, University of Illinois. The only practical way to get this into the soil where it is available for crops is through the use of legumes.

—*Prairie Farmer* (Illinois).

COLLEGE AND ALUMNI NOTES

Dr. B. M. Gonzalez was elected on September 3 member of the Board of Directors of the Pampanga Sugar Development Co. This sugar central has just paid off its indebtedness with the Philippine National Bank, being the first of the bank centrals to accomplish this feat.

Dr. Shuta Kinoshita, Chief Entomologist of the Imperial Agricultural Experiment Station, Nishigahara, Tokyo, Japan, was a Campus visitor on September 5. Doctor Kinoshita is on a six months' survey trip of the East, studying parasites of the rice borer for possible introduction into Japan. From the Philippines he will proceed to Borneo, Java, Indo-China, and India.

Mr. Clyde C. Coulter, Field Secretary of the American Mission to Lepers, Inc., addressed the Student Body in August. Mr. Coulter told in a concise, forceful manner of the enormous numbers of lepers in the world and what is being done to lessen their suffering, and what science is doing in finding a permanent cure for the disease. Mr. Coulter made a strong plea for each one to do what he can to help rid the Philippines of this, "the most terrible disease in the world." In the Philippines, small country as it is, the estimated number of lepers is around 15,000.

Dr. Nemesio B. Mendiola, who was in residence in Java for one year as a Rockefeller International Education Board Fellow, returned to Los Baños, August 24, 1927. Doctor Mendiola has been appointed acting head of the Department of Agronomy, effective August 31, 1927.

Dr. Manuel L. Roxas and Prof. Cecilio Alincastre, both of the Sugar Technology Division are again on leave without pay for the second semester of this year. Doctor Roxas is Cane Technologist for the Philippine Sugar Association and Professor Alincastre is Superintendent of the Lopez Sugar Central at Fábrica, Occ. Negros.

Professor Hilarion G. Henares of the Agricultural Chemistry Department is now connected with the Earnshaw Docks and Honolulu Iron Works as constructing engineer. He is at present in charge of the construction of the new Lopez Sugar Central located at Fábrica, Occidental Negros.

After a stay of three years in the United States where he studied Agricultural Engineering, specializing in irrigation, drainage, and sanitation at the universities of Colorado and Cornell, Dr. Alexander Gordon, B. Agr., '23, returned to the Philippines on the *S. S. President Taft* on August 18. Doctor Gordon reported for duty on August 29 in the Department of Agricultural Engineering.

Doctor Gordon received his master's and doctor's degrees from Cornell University.

The Chemistry "L" and the biological laboratory are now completed and in use. Part of the "L" is used as a lecture room for general chemistry; the Experiment Station Food Laboratory is in another part. This arrangement temporarily relieves congestion in the Chemistry Department laboratories. The biological laboratory will house the experimental animals used by Doctor Santos and Mr. Collado in connection with nutrition experiments.

The School of Forestry Wood Still Plant is now in operation. The plant was constructed and will be run by the School of Forestry in co-operation with the Department of Chemistry of the College of Agriculture.

Work on the Armory-Gymnasium for the Los Baños Colleges is now in progress. This building will be used for auditorium also, as the present hall is not large enough to accommodate one-half the student body.

Mr. Victorino M. Kilayko, Assistant in Chemistry, resigned August 31, 1927, to accept a more remunerative position with the Bacolod-Murcia Milling Company in Negros. Mr. Kilayko is a B. S. in Sugar Engineering from the University of Louisiana, Class of 1926.

Mr. Victor Sulit, Instructor in Agricultural Chemistry, sailed for the United States on the *S. S. President Taft*, on August 20, 1927. Mr. Sulit goes as University Fellow to the University of Chicago. He will major in general chemistry and study rubber as a minor subject. He also plans to visit different industrial plants in the United States and Europe after obtaining the doctor's degree.

Mr. Hermenegildo R. Rosales, B. S. A., '26, (Sugar Technology Curriculum) visited the College on September 7, 1927. Mr. Rosales came to take his oral examination for the Certificate in Sugar Technology. While away from his post he attended the Fifth Annual Convention of the Philippine Sugar Association as a delegate from Isabela, Occidental Negros, where he is employed as a Planters' Chemist.

With Dr. Gregorio San Agustin tossing the first ball and Physical Director Gerónimo Suva refereeing the first basketball game, the 1927-1928 U. P. Los Baños Athletic League was begun August 23, with a large attendance of faculty members and students from the Los Baños Colleges. In the opening games in basket ball, the Veterinary team won a hard-fought contest from the Forestry team, 26-24, while the C. A. Seniors easily defeated the C. A. Juniors, 54-24. In the first volley ball game of the League, the C. A. Sophomores were victorious over the C. A. Freshmen in two straight sets, 21-16, and 21-13.

All League games are scheduled to be played on Tuesday and Thursday afternoons.

The standing of teams to date (September 9) follows:

<i>Basket ball</i>		<i>Volley ball</i>	
C. A. Seniors.....	30 points	C. A. Sophomores.....	20 points
Veterinary.....	20 "	C. A. Preparatory.....	20 "
C. A. Sophomores.....	20 "	C. A. Juniors.....	15 "
C. A. Freshmen.....	10 "	C. A. Freshmen.....	15 "
C. A. Preparatory.....	10 "	Veterinary.....	10 "
C. A. Juniors.....	0 "	C. A. Seniors.....	5 "
Forestry.....	0 "	Forestry.....	5 "

Every Wednesday afternoon a special girls' class in Physical Training for the eighteen co-eds in the College of Agriculture is being conducted by the Department of Physical Education. Elementary gymnastics, marching, folk dancing, games, and outdoor sports are given in the course.

The Association of Junior Sugar Technologists celebrated Sugar Technology Day, August 26, with a program in the Auditorium in the evening, and were hosts the following evening at a dance. Among "off-the-Campus" guests were women students from the U. P. and Philippine Normal, and from Lipa and Batangas.

Features of the program were a talk on the Sugar Situation in the Philippines by Dr. Manuel Roxas; a short drama "A Romance of Miss Sugar Cane," written by a member of the club; and a recitation "Curfew Must Not Ring Tonight" by Miss Gonzales of Manila. Piano selections by Misses Imelda Katigbak and Soledad Arguelles of Lipa and a vocal duet by Miss Mamerta Manahan and Lieutenant Catalan and a solo by Miss Manahan, were the musical numbers. Special attractions were the "Balitao," a Filipino dance, by Miss Rosario Maralit and Mr. Vicente Umali of Batangas, and selections on the harmonica by Shogo Uno of the College.

The personnel of the Department of Physical Education for this year is: Director Gerónimo Suva; Instructor, Ramón P. Tolentino, Jr.; Assistants Jacinto B. Leoncio and Sixto L. Sison; Property Custodian, Hermenegildo Masaya.

The committees for the year for Los Baños Colleges Athletic Association are:

Athletic Management: Dr. B. M. Gonzalez and Roberto Betia (Agriculture), Dr. Gregorio San Agustin and Lieut. Nemesio Catalan (Vet. Science), Prof. Carlos Sulit and Juanito Ilustrísimo (Forestry), Lieut. Amado Martelino, Mr. Alfredo Yñiguez, and Mr. Ramón P. Tolentino, Jr., Members Ex-Officio. Mr. Yñiguez is Treasurer and Mr. Tolentino is Secretary.

Intramural Athletic Committee: Mr. Ramón P. Tolentino, Jr., Chairman. Members from Agriculture: Roberto Betia (Senior), Felixberto Relova (Junior), José S. Austria (Sophomore), Filemón Ampog (Freshman), Antonio Garganta (Preparatory), Pedro Beriña (Vet. Science), Valentin Semilla (Forestry). Mr. Canuto Manuel is Coach for Freshmen and Mr. Pedro Rodrigo for Preparatory.

The team Coaches are: Baseball Dr. Angel K. Gomes; basket ball, Dr. Alexander Gordon; soccer football, Ramón Hofileña; track and field, Mr. Ramón P. Tolentino, Jr.

THE GLORY OF THE GARDEN

Our England is a garden that is full of stately views,
Of borders, beds and shrubberies and lawns and avenues
With statues on the terraces and peacocks strutting by;
But the Glory of the Garden lies in more than meets the eye.

For where the old thick laurels grow, along the thin red wall,
You'll find the tool- and potting-sheds which are the heart of all,
The cold-frames and the hothouses, the dung-pits and the tanks,
The rollers, carts, and drainpipes, with the barrows and the planks.

And there you'll see the gardeners, the men and 'prentice boys
Told off to do as they are bid and do it without noise;
For, except when seeds are planted and we shout to scare the birds,
The Glory of the Garden it abideth not in words.

And some can pot begonias and some can bud a rose,
And some are hardly fit to trust with anything that grows;
But they can roll and trim the lawns and sift the sand and loam
For the Glory of the Garden occupieth all who come.

Our England is a garden and such gardens are not made
By singing:—"Oh, how beautiful," and sitting in the shade
While better men than we go out and start their working lives
At grubbing weeds from gravel paths with broken dinner knives.

There's not a pair of legs so thin, there's not a head so thick,
There's not a hand so weak and white, nor yet a heart so sick,
But it can find some needful job that's crying to be done
For the Glory of the Garden glorifieth every one.

Then seek your job with thankfulness and work till further orders,
If it's only netting strawberries or killing slugs on borders,
And when your back stops aching and your hands begin to harden
You will find yourself a partner in the Glory of the Garden.

Oh! Adam was a gardener, and God who made him sees
That half a proper gardener's work is done upon his knees.
So when your work is finished, you can wash your hands and pray
For the Glory of the Garden that it may not pass away.

—RUDYARD KIPLING.

GARDENING, AN ANCIENT ACTIVITY

Extracts from article in *Gardeners' Chronicle* (New York.)

... In architecture, plants and flowers have furnished the prototypes for many historical styles of ornamentation. I need only to remind you of the Acanthus of the Greeks; the Lotus, so typical of ancient Egypt and no less sacred in the architectural ideas of the Chinese and Hindoos; the Rose in the Middle Ages (the Rose Window); the symbolic trefoil of ecclesiastical ornamentation. I can do no more than hint at the vast part which flowers and plants have played and are still playing in the arts and crafts of the world.

* * * * *

But they had yet another influence, they led man into the primitive paths of science. He had learned by experience that while certain plants and flowers afforded him relief from physical inconvenience or pain, others were very harmful in their effects. So he studied their structure and nature more closely, noted their characteristic efficacy or injury. Here was the beginning of the botanical and medicinal sciences.

... In the craft of gardening, we probably have the most ancient domestic activity of man. The Garden of Eden at once suggests itself. Among the Seven Wonders of the Ancient World were the Hanging Gardens of Babylon, created to please Semiramis, the queen. In fact, many ancient fragments of literature give proof of the esteem of and care devoted to gardens, the pride in their extent and beauty.

Never has the art of gardening been held in greater honor than it was among the Egyptians two or three thousand years ago. In Egypt, the garden was of far greater importance than with us at the present time. ... Funeral obsequies were celebrated in the garden of the deceased, his grave was adorned with a miniature reproduction of it. ... The guest was given his first welcome in the garden; he received a flower which he must hold in his hand throughout his stay. Besides the sacred Lotus, ancient Egypt cultivated Chrysanthemums, Centaureas, Poppies, Convolvulus, Thistles—an improved variety of which, by the way, is a favorite in certain garden schemes today, proving the old adage "There is nothing new under the sun".

It is very probable that the Greeks and Romans learned their horticultural art in Egypt. We have abundant allusions in the classic writings to the skill and care exercised in procuring a varied supply of flowers for ceremonial use. The temples were decked with them. They were used as votive offerings to the gods. Triumphal processions passed over flower strewn streets, while choice flowers rained down on the participants. Indeed, the Floralia was their own special festivity in Spring, of which May Day with its garlands and rustic merry-making is a modern survival. At Roman feasts guests wore garlands of flowers tied with Linden bark to prevent intoxication. The banquet hall, the dishes, the cups, the waiters,

all were adorned with flowers. And as symbolic meanings were attached to the different flowers and plants, it was a nice art to use just the right combinations demanded by the occasion and the social importance of the guests. Garlands, too, were tossed to the actors on the stage; they were the badges of victory.

Among the Orientals the art of gardening was also well developed and no less esteemed. Of Persian garden art, ancient rugs and their descriptions give us a good idea. There is a Chinese poem of the tenth century devoted to the description of a wonderful garden, giving proof of the antiquity of that unique art for which China is famous even today.

That the art of garden planning and planting was highly developed in Italy is not strange. It was the direct heritage of Roman horticulture. . . .

Many historic gardens have existed in China, and a point worthy of notice is, that a couple of hundred years before the Christian Era, the Emperor Wu of Han created an immense pleasure ground called Shang Lin, or Royal Park, where he desired to spend happy days and hours. However, public opinion, always so powerful in China, frowned upon this monopolization of arable land and he was obliged to give up his park and allow the farmers to put it under cultivation again. This incident is an example of the fact that the Chinese have never permitted an individual, no matter how high his rank, to absorb too much ground for his private use. Gardens, though full of hills, lakes, valleys and vistas, in reality occupy a comparatively small space, and extensive private pleasure grounds, with large lawns, wide herbaceous borders, and elaborate parterres such as are common in the West, would not be tolerated for a moment. A Chinese has always been obliged to confine his garden within a small space and has never been allowed to seriously interfere with the most important business of life—that is agriculture. In this connection it may be recalled that, according to the Chinese division, the four Classes of Society are: first, Scholars; second, Agriculturists; third, Labourers; fourth, Traders. Soldiers, sailors, and other classes whom we honour are not considered as worthy of mention in the social system.

* * * * *

There are many treatises in Chinese on the growing of flowers. Early in the eleventh century, soon after William the Conqueror invaded Britain, a certain Liu Ming wrote a work on chrysanthemums, dividing these flowers into thirty-five varieties; and a writer of the Yuan dynasty, which flourished about the time of Edward I, divided the *moutan* peony into thirty-nine classes.—FLORENCE AYSCOUGH. In *A Chinese Mirror*.

There are over two hundred natural families of flowering plants with seventy-six hundred general and well over one hundred thousand species

and varieties. The species of the flowerless plants, which include microscopic fungi, lichens, ferns, mosses, and mushrooms, are more numerous than the flowering plants. . . .

The Rose family (Rosacea) may be called the fruit family, as in this group are apples, pears, quinces, plums, apricots, almonds, cherries, raspberries. *Prunus* includes the stone fruits with well over one hundred species in many parts of the world. *Pyrus*, including apples, pears, Mountain Ash, has more than forty species. Of Roses, more than two hundred fifty species have been described at various times. This family also embraces strawberries and *Spireas*, and in all totals some one thousand species and varieties.

Three hundred fifty and more species of *Begonias* are known to botanists. By far the largest order is the Composite group or Sunflower family, containing nearly eight hundred genera with ten thousand species. Very few of the species furnish esculent parts, the chief being lettuce, chicory, artichoke, and salsify. The family comprises great numbers of ornamental plants, the most prominent of which is the *Chrysanthemum*. . . .

The Palm family (*Palmae*) includes eleven hundred fifty species, some of which produce edible fruits, the best known being dates and coconuts.

The Grass family (*Graminea*) is the most important of all, with wheat, oats, Indian corn, sugar cane, barley, and the like among its members. There are over three thousand species to this family.

—*Gardeners' Chronicle* (New York.)

An ideal man of science is a man of his own time and rather a harbinger of the coming age than a representative of the bygone ones. He is thoroughly human, and therefore never exclusively engrossed by his own special work, though he gives it his days and sometimes his nights. He is eager for every noble cause, responsive to the great calls of his age, and endowed with a beautifully furnished mind. He is no stranger to the invaluable treasures which the ancients bequeathed to us. Their poetry, their philosophy appeal to him. He finds therein a matchless refreshment, which makes him the more keen-witted, the more clear-sighted for his own investigations.

L. LEVY-BRUHL.

The great end of life is not knowledge but action.—THOMAS HUXLEY.

OBSERVATIONS ON RANGE CATTLE AT THE HACIENDA DEL ROSARIO, CAINTA, RIZAL¹

VALENTE VILLEGAS AND FELIX B. SARAO
Of the Department of Animal Husbandry

From May 9 to 13, 1927, the writers were in charge of laboratory practice performed by students of a cattle husbandry class of the College of Agriculture, University of the Philippines, at the Hacienda del Rosario, Cainta, Rizal. The work consisted of roping and throwing down animals for branding, and the castration of bulls unsuitable for breeding purposes. This work gave an opportunity for making observations on the cattle of the ranch, which in the opinion of the writers typify the class of animals found on many of the ranches in the Philippines.

There were 152 cattle included in this study. Studies were made as to their sex, color, breeding, age, height, and conformation. They were selected principally on the bases of age, size, and conformation, and then classified according to their suitability for breeding, work, and slaughter.

All the animals were pastured on an area of about 400 hectares, being transferred from one section to another for rotation purposes. The pastures are generally very well drained and a creek of clear flowing water crosses the ranch to furnish sufficient clean water throughout the whole year. On the lowlands, amor seco (*Andropogon aciculatus* Retz.) forms the main forage supply, while on the hillsides, cogon (*Imperata cylindrica* var. *koenigii* (Retz.) Benth. ex Pilger) and talahib (*Saccharum spontaneum* L.) prevail. Trees of various species grow on the pastures and furnish shade for the cattle at midday.

As part of the improvement work being developed by Doctor Tubangui, two bulls from the College of Agriculture, University of the Philippines, were acquired for breeding purposes. One of these was of $\frac{3}{4}$ Nellore- $\frac{1}{4}$ Native breeding which at four years of age weighed 460 kilograms and was 134 centimeters high. The other bull was of $\frac{1}{2}$ Hereford- $\frac{1}{2}$ Native breeding, which at four years and nine months of age weighed 440 kilograms and measured 125 centimeters in height. Besides these two, a grade Nellore bull, 125 centimeters in height, was used for grading up purposes. Twenty-one other bulls which were small or otherwise poor in conformation were castrated. The influence of the three selected bulls will begin to show in the 1928 calf crop, and thereafter.

¹ Experiment Station contribution No. 468. Received for publication October 1, 1927.

The writers are indebted to Dr. M. A. Tubangui, in charge of the ranch, through whose courtesy the data presented herewith were secured.

During the rainy season when pasturage is plentiful the herd has the freedom of the range in the daytime and is corralled at night to prevent animals straying away. In the dry season when the grass is short and poor the herd is confined at night only twice a week. Salt is given in the corral in the evening. Two men take charge of herding the animals and doing other work on the ranch, such as salting, reporting births, accidents, and diseases in the herd, and catching the animals for the market or for treatment, repairing the fences and corrals, etc.

SEX

At the time of this study eighty-five of the animals, representing 55.9 per cent, were females, of which nine were calves. There were 24 bulls, or 15.8 per cent, 21 of which were calves, and three were mature breeding bulls, the ones previously mentioned. The remaining 43 animals, or 28.3 per cent were steers, 21 of which were castrated at the time this study was made. (See table 1.)

COLOR

Seven colors were shown by the animals; namely, black, red, white, fawn, yellow, roan, and red and white. Black predominated, 46 or 30.3 per cent of the animals being of this color. The next predominating color was red, there being 39 or 25.6 per cent. There were 30 or 19.7 per cent white animals; 24 or 15.8 per cent fawn and 11 or 7.2 per cent yellow. Only one roan animal was in the herd and one red and white. (See table 1.)

BREEDING

The majority of the animals were grade Indian, there being 145 or 95.4 per cent. From the looks of the animals it was apparent that the amount of Indian blood in the animals was low although characteristic Indian points were manifest. Only the two grade Indian breeding bulls were of high Indian blood. There were six cows or 3.9 per cent of native breeding, these being old foundation cows of the herd. One grade Hereford bull was used for breeding purposes. (See table 1.)

The age of the animals was determined according to the replacement of the temporary incisors by permanent teeth.²

At the time of observation there were 31 calves and the same number of weanlings, constituting in all 40.8 per cent of the animals. There were 21 two-year-olds or 13.8 per cent; 17 three-year-olds or 11.2 per cent; 15 four-year-olds or 8.5 per cent; and 25 medium-aged and old animals, or 16.5 per cent. The latter included those that were over five years of age. (See table 1.) This seeming large number of young stock might indicate a high percentage of breeding ability of the cows, but the writers were informed that a number of cows in good condition had been sold for slaughter.

²Pope W. George. 1919. Determining the age of cattle by the teeth. U. S. Dept. Agric. Farmers' Bull. 1066: 4. Fig. 1-6.

HEIGHT

As an index of size, height was secured. While the animal was cast down the height was taken by measuring the distance from the top of the withers just behind the hump to the tip of toe. The height of calves was not determined inasmuch as there was no way of telling their approximate age up to two years of age. The medium-aged and old cattle were classified together, assuming that their height is stationary after they are five years old. From table 2, it will be seen that the average height of two-year-olds was 105.4 centimeters. Comparing this with the average for three-year-olds, 107.4 centimeters, it is clear that the three-year-olds were 1.9 per cent taller than the two-year-olds. The four-year-olds averaged 109.8 centimeters in height, or 4.2 per cent taller than the two-year-olds. Cattle of five years of age were, on the average, 110.7 centimeters in height, or 5.0 per cent taller than the two-year-olds. In the case of medium-aged and old animals the average height was 110 centimeters or 4.4 per cent taller than the two-year-olds, but 0.7 centimeters lower than the average for five-year-olds. The smaller size shown by medium-aged and old animals was probably due to the presence of several native cows in the herd and to the seemingly lower concentration of Indian blood among the rest of the animals.

Comparing the heights of these animals with those of the College of Agriculture (see table 3), it may be seen that the two-year-olds of the College had an average height of 115.2 centimeters or 9.3 per cent taller than those of the ranch. The College three-year-olds measured on an average 124.1 centimeters or 15.5 per cent taller. The four-year-olds, although only three animals, averaged 124.7 centimeters or 13.6 per cent taller. The outstanding superiority in height of the animals at the College of Agriculture is due to the use of better stock, particularly bulls, and the higher concentration of improved blood in the animals.

CLASSIFICATION

According to table 4, 44.7 per cent of the herd or 68, represented breeding cows. This did not include the female calves, or 19.7 per cent, which were too young to be classified. There were 44 steers or 28.9 per cent, of which 21 or 13.8 per cent of the total showed sufficient merit to be retained and raised as work stock, while the remaining 23 or 15.1 per cent were poor and suitable only for slaughtering purposes. Seven cows or 4.6 per cent were classified as butcher stock because of unusual small size. For breeding purposes three bulls or two per cent were left in the herd.

SUMMARY

This study includes 152 animals representing the type of cattle generally seen on ranches in the Islands.

Ample pasturage is provided for the animals during the great part of the year, shortage of forage being experienced for a brief period during the hottest month of summer. The rotation of pastures increases the carrying capacity. Good water supply is obtained from a creek. The animals are salted at regular intervals.

The majority of the animals were females. There was a good number of marketable steers suitable for slaughter and for work. Of the bulls, three were kept for breeding purposes while the rest were calves too young to be castrated.

The colors represented were black, red, white, fawn, yellow, roan, and red and white. About one-third were black and about one-fourth were red.

Over 95 per cent of the herd were Indian grades. One bull was a Hereford grade bull used for breeding purposes. The rest were old native foundation cows.

Young animals up to five years of age constituted about 85 per cent of the herd, the rest being older cattle. Over 40 per cent were calves and weanlings.

The size of the animals as shown by height was low compared with grade Nellores at the College of Agriculture. This smaller size was due mainly to better bulls being used in the College and the higher composition of improved blood.

Based on size, age, and conformation, there were about 45 per cent of breeding cows, about 20 per cent of butcher stock, about 14 per cent of work steers and about 20 per cent of nursing calves. Two per cent (3) were bulls kept for breeding purposes.

OBSERVATIONS ON RANGE CATTLE

TABLE 1

Showing the distribution of sex, color, breeding, and age among the animals

DISTRIBUTION	NUMBER	PER CENT
Sex:		
Cows.....	85	55.9
Steers.....	43	28.3
Bulls.....	24	15.8
Color:		
Black.....	46	30.3
Red.....	39	25.6
White.....	30	19.7
Fawn.....	24	15.8
Yellow.....	11	7.2
Roan.....	1	0.7
Red and white.....	1	0.7
Breeding:		
Indian grade.....	145	95.4
Native.....	6	3.9
Hereford grade.....	1	0.7
Age:		
Calves.....	31	20.4
Weanlings.....	31	20.4
Medium-aged and old animals.....	25	16.5
Two-year-olds.....	21	13.8
Three-year-olds.....	17	11.2
Four-year-olds.....	14	9.2
Five-year-olds.....	13	8.5

TABLE 2

Showing the average height of cattle of different ages at the Hacienda del Rosario

2 YEAR-OLDS		3 YEAR-OLDS		4 YEAR-OLDS		5 YEAR-OLDS		MEDIUM-AGED AND OLD ANIMALS	
Brand No.	Height cm.	Brand No.	Height cm.	Brand No.	Height cm.	Brand No.	Height cm.	Brand No.	Height cm.
31	101	35	120	29	100	3	108	21	106
33	96	37	102	32	115	40	108	27	109
36	105	49	107	34	112	41	120	30	116
38	101	5	106	48	96	46	110	58	108
39	100	64	96	*61	117	55	104	69	113
42	106	65	113	73	106	59	114	70	109
43	107	67	107	78	112	62	110	71	111
44	112	81	106	91	114	74	109	75	114
45	100	87	112	96	113	88	109	76	116
51	104	94	109	100	113	113	108	77	111
54	109	98	101	112	111	116	121	80	113
57	104	107	107	123	113	126	108	84	104
68	109	115	113	124	106			85	110
83	111	119	106					86	104
95	105	122	106					89	112
97	112	125	108					90	111
99	104							103	105
102	116							108	108
109	104							114	104
110	104							117	115
111	104							118	114
Average.	105.4		107.4		109.8		110.7	120	111
								121	106
									110

TABLE 3

Showing the average height of cattle of different ages at the College of Agriculture

NAME	2 YEARS OLD	3 YEARS OLD	4 YEARS OLD
	cm.	cm.	cm.
1/2 Nellore—1/2 Native			
Active.....	108.0	120.5	123.0
Aladdin.....	113.5	—	—
Virginia.....	110.0	—	—
Alice.....	109.0	—	—
Dulcinea.....	110.0	—	—
1/2 Hereford—1/4 Nellore—1/4 Native			
Elisa.....	116.5	116.5	116.5
Loyalty.....	118.0	124.5	—
Shine.....	111.0	113.5	—
Priscilla.....	113.5	—	—
Evangeline.....	112.0	—	—
3/4 Nellore—1/4 Native			
Victor.....	123.0	134.5	134.5
Prospect's Lad.....	116.5	118.0	—
Juliet.....	111.5	—	—
1/2 Nellore—1/2 Hereford			
November 5th.....	123.0	130.5	—
November 8th.....	123.0	130.0	—
Provincial Fair.....	119.0	129.0	—
Romeo.....	121.0	—	—
Average.....	115.2	124.1	124.7

TABLE 4

Showing the classification of animals at the Hacienda del Rosario

CLASS	NUMBER	PER CENT
Breeding bulls.....	3	2.0
Breeding cows.....	68	44.7
Work steers.....	21	13.8
Butcher cows.....	7	4.6
Butcher steers.....	23	15.1
Nursing calves.....	30	19.7
Total.....	152	99.9

THE SUGAR CANE LEAF-HOPPER, PERKINSIELLA VASTATRIX BREDDIN (DELPHACIDAE, HOMOPTERA)¹

CORNELIO M. URBINO

WITH TWO PLATES AND THREE CHARTS

INTRODUCTION

The sugar cane leaf-hopper, *Perkinsiella vastatrix* Breddin, is one of the relatively important pests of sugar cane in the Philippines. On account of the semigregarious habits of both the nymphs and the adults, their work is often followed by serious injury during months when they are abundant. The weakening of the plants, resulting from direct effect of feeding, is evidently frequently followed by infection through the punctures by pathogenic micro-organisms. The wounds opened in the leaf midribs (pl. 2) and leaf sheaths (pl. 2), and even in stems (pl. 2), by the ovipositor as the female lays her eggs are not infrequently attended by similar complications.

At the present time, the pest seems to be adequately controlled through the greater part of the year by natural enemies, especially egg parasites, so that apparently it presents no real immediate problem to sugar cane culture in the Philippines. Yet the occasional outbreaks in large numbers in Los Baños and other localities tend to show that the existing natural check does not upset the balance of Nature heavily enough. The menace hangs, like the sword of Damocles, with the suspending thin hair of natural enemies temporarily keeping it from its destructive work.

Review of literature

Breddin (1896) published the earliest recognizable record of this species under the name *Dicranotropis vastatrix* n. sp. His description was based on Javanese specimens collected by Doctor Krueger, on whose authority Breddin noted that the insect was "auf Java sehr verbreitet; lebt verborgen hinter den Blattscheiden und sticht diese und den Blattnerve, worin auch die Eier abgelegt werden an." In addition to sugar cane, sorghum was mentioned as a host. The insect was removed from *Dicranotropis* and transferred to *Perkinsiella* by Kirkaldy (1907).

A number of Dutch and other European entomologists working in Java published accounts on *P. vastatrix*. These papers were mostly short, general descriptions of egg, nymphs, adults, and work on the sugar cane.

¹Thesis presented for graduation, 1927, with the degree of Bachelor of Agriculture from the College of Agriculture No. 257; Experiment Station contribution No. 468. Prepared in the Department of Entomology under the direction of Associate Professor Leopoldo B. Uichanco.

Among these authors were Zehntner (1897), Krueger (1899), Van Deventer (1906), and Dammerman (1919).

Mention of the occurrence of this species in Japan and in Formosa was confined to a short fragmentary statement in the *Bericht über das zoologische Museum in Rechnungsjahr 1914*, 8: 133. This same unsatisfactory condition holds true in the Philippines, where among others, Muir (1916) merely recorded the insect in a systematic paper on Delphacidae, and Copeland (1916) listed it among sugar cane insects. In other countries enumerated under the heading "Geographical Distribution" the situation is not much better. Indeed, so far as the writer knows, there is at present no publication which even approaches a fairly comprehensive account of the life history, habits, and other biological phenomena relative to this important pest.

Geographical distribution, with remarks on host plants

A fairly extensive search of the literature indicates the following geographical range of *Perkinsiella vastatrix*.

*Oriental Region*²

<i>Countries</i>	<i>Authorities</i>
Federated Malay States	Corbett and Gater (1926)
Java	Bredden (1896)
	Zehntner (1897)
	Krueger (1899)
	Van Deventer (1906)
Celebes	Krueger (1899)
Sunda Isles; Formosa	Matsumura (1914)
Amboina	Muir (1910)
Ceram	
Papua	
Philippines	

Palaeartic Region

Japan	Matsumura (1914)
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It will be seen from the foregoing data that this species is apparently confined to a small portion of the Eastern Hemisphere, specifically the Oriental Region and a small part of the Palaeartic. It is inconceivable that if *Perkinsiella vastatrix* occurred in other regions it would not be recorded, since entomological work has been fairly extensive in many of the countries not included in the present list.

This fact is significant in that it indicates that the species is probably an original component of the Oriental fauna. It is perhaps autochthonous

²The classification into geographical regions is based on Wallace, Alfred Russel, 1876. *Geographical distribution of animals* 1: 503 p. London.

in the Philippines, in common with the other countries in the Oriental Region, as is further evident from the large number of specific parasites associated with it. It may likewise be presumed that the original host of the insect was some native grass, probably *Saccharum spontaneum* subsp. *indicum* Hack (talahib), later, taking to the sugar cane, which is of prehistoric introduction in the Philippines. Apparently sugar cane subsequently became the preferred host, since in localities where this crop is planted, the talahib for a considerable distance from sugar cane plantations, even in months of greatest abundance of *P. vastatrix*, has been found to be absolutely free from the insect. It is, moreover, worthy of note in this connection that in the course of the present work no grass or other plant species was found to serve as alternative host for *Perkinsiella* in the Philippines. In Java (Breddin, 1896, on the authority of Krueger), sorghum is reported as additional host; and corn in the Federated Malay States (Corbett and Gater, 1926).

Systematic consideration

Perkinsiella vastatrix Breddin¹ belongs to the family Delphacidae, tribe Delphacini (Homoptera). Muir (1916) records six species under this genus in the Philippines, four of which, *bakeri* Muir, (?) *saccharivora* Muir, *lineata* Muir, and the present species, are found on sugar cane. Of these, however, *P. vastatrix* is apparently the only real pest of this crop, the others being too uncommon to be of economic importance.

It is worthy of note that *P. saccharicida*, which is so destructive in the Hawaiian and Javanese cane fields, is either absent or very rare in the Philippines; published reports of Banks (1906) and other authors to the contrary.

Object of the present work

The object of the present work was to study the biology of *Perkinsiella vastatrix* with special reference to control measures suited to Philippine conditions.

Time and place

The work covered a period of approximately one and one-half years, from July, 1925, to January, 1927. Experiments and observations were conducted both in the laboratory and in the cane fields of the College of Agriculture, Los Baños, Laguna. Also, trips were made to the farms in the vicinity of the College campus and elsewhere.

MATERIALS AND METHODS

A number of insectary methods were tried in life history work. The most convenient, and likewise the most satisfactory, method was to use small sugar cane transplanted in pots and introduce nymph or adult hoppers thereon, as the case demanded. Small glass lamp chimneys, covered

¹Thanks are due to Dean Charles F. Baker for the identification of these specimens.

over the top with cheese cloth, provided adequate breeding cages. Cut leaves were found unsuitable for the present purpose.

Leaves containing egg clusters were collected, cut into suitable lengths and confined in battery jars for rearing first-instar nymphs and egg parasites. The lower ends of the leaves were immersed in vials of water to prevent too rapid drying.

For preservation of insect materials for study, eggs, nymphs, and adults were fixed in water at about 80°C. for ten minutes, then transferred to 80 per cent alcohol, where they were left until used. Some of the specimens were carried through the higher grades of alcohol and finally mounted in balsam. In the case of nymphs and adults, previous maceration in 5 per cent aqueous solution of potassium hydrate was resorted to in order to bring out anatomical details in the exoskeleton. Gage's stain for Coccidae was employed to good advantage.

A series of dry adult specimens on pins was also kept for comparison. Fresh material of all stages was used as check.

EXPERIMENTS AND RESULTS

Descriptions

Egg (pl. 1, fig. 1). Length 1.11 millimeters, width 0.22, thickness 0.21. Elongately subcrescentic, conspicuously smaller toward anterior than posterior pole; a cup-shaped, transparent cap fitting closely around anterior end and becoming detached as the young insect hatches; posterior end rounded; concave ventrally and correspondingly convex dorsally; opaque brownish white, with irregular internal red mass showing through anterior end some time prior to hatching. Freshly laid egg delicate; hard and brittle as it grows older.

Adult male (pl. 1, fig. 7). Length of body (exclusive of appendages) 3.4 millimeters; width 1.3; length of head 0.34; width 1.3; length of antenna 0.34; width 0.93; length of fore wing 4.3; width 1.22; length of hind wing 3.02; width 1.55.

General color of body light yellowish brown, but darker brown on the following parts: anterior portion of head, especially between carinae, pronotum, scutellum, and tarsi. Fuscous as follows: abdominal tergites and sternites, tibial and tarsal spurs, and eyes.

Head vaguely subovate from dorsal aspect, triangular from frontal and lateral; about one-tenth as long as total length of body. Labium subcylindrical, covered with numerous fine hairs, three-segmented, segment I obscure, II subcylindrical, slightly swollen proximally and distally, about four times as long as broad, about five-ninths total length of labium; III elongately subpyriform, about four-fifths as long as II and slightly smaller in diameter, about four times as long as greatest diameter, apex blunt. Mandibular seta subfiliform, abruptly enlarged basally into a broadly subconical process which is twelve times as long as diameter at base, and

five times as broad as main part of seta; slightly swollen into subellipsoidal apex; total length of seta about sixty-five times diameter at base; maxillary seta subfiliform, abruptly enlarged basally into a broad, obliquely subconical process which is about twice as broad as base of mandibular seta, about nine times as long as diameter at base and about eleven times as broad as main part of seta, gradually terminating distally into slightly attenuate, rounded apex. Labium vaguely subtriangular, about one-half as long as labial segment II and about twice as long as broad. Clypeus subtriangular, about twice as long as labrum, about one and one-third times as long as broad. Genae not prominent, with lateral margin nearly confluent with those of clypeus and labrum; subcoextensive with the two latter structures. Ocelli not in evidence. Frons subrectangular, about twice as long as broad, tripartite, with a carina on either side longitudinally midway between mesal depression and margin of eye, meeting into an acute angle at point equidistant from frontoclypeal suture and from anterior margin of head at vertex; a transverse carina midway between anterior margin of vertex and occipital margin, which with the two longitudinal carinae noted above and another short posteromesal, longitudinal carina divide head from dorsal aspect into five subequal, vaguely subcircular, depressed areas. Antenna about five times as long as width of vertex; two short proximal segments, scape and pedicel; sixteen segmented bristle-like terminal clavola. Scape short and stout, slightly enlarged toward distal end, with numerous irregularly arranged spines, interspersed with very minute hairs distally; about twice as long as broad. Pedicel subcylindrical, about one and one-third times as long as broad, slightly swollen at middle, covered with numerous minute hairs, spines, and sensoria, which are arranged in rings, except at base. Basal segment of clavola flask shaped, with a few successive, irregular, almost inconspicuous, ringlike elevations; numerous minute hairs; about one and one-half times as long as broad, about one-fifth as broad as pedicel; more distal segments, except apical, rugulose, gradually increasing successively in length and decreasing in diameter; apical segment about one-third total length of clavola. Eyes irregularly subhemispherical, dark reddish brown, large and prominent.

Thorax about as long as broad, about one-third total length of body. Prothorax abruptly attenuate anteriorly; pronotum subreniform, posterior margin concave, anterior convex, about one-fourth as long as broad, slightly broader than head, tricarinate; carinae subconfluent with those of head. Mesoscutellum tricarinate, about two and one-half times as long and nearly as broad as pronotum, about one and one-third times as long as broad, produced into an acute angle distally. Metathorax slightly shorter and nearly as broad as prothorax, metascutellum about two-thirds as long and one-third as broad as mesoscutellum, about one and one-third as long as broad. Prothoracic leg (pl. 1, fig. 12) covered with numerous hairs and spines. Coxa subcylindrical, slightly incrassate subdistally, covered with numerous minute hairs, sparsely beset with bristles, about two and one-half

times as long as broad; trochantin and trochanter visible as two distinct sclerites. Femur slightly attenuate distally, about as long as coxa, irregularly covered ectally with numerous short bristles; ental depression with linear rows of short bristles on either side at margin; about five times as long as broad. Tibia subcylindrical, slightly incrassate distally, subequal in length to and about three-fourths as broad as femur, about eight times as long as broad, covered with numerous minute bristles arranged in subregular linear rows. Tarsus about one-half as long, and nearly as broad as tibia, three-segmented, covered with numerous bristles; segment I subtrapezoidal, acutely angulate entodistally, about twice as long as broad; II subtrapezoidal, acutely angulate ectoproximally, less so entodistally, about twice as long as broad, and about one and one-third as long and also as broad as I; III subcylindrical, about two and one-half times as long as broad, about as broad as II, acutely angular ectoproximally. Unguis about one and one-fourth as long as breadth at base. Mesothoracic leg (pl. 1, fig. 13) about as long as prothoracic. In characters of parts and relative proportions similar to prothoracic leg. Metathoracic leg (pl. 1, fig. 14) about one and one-fifth times as long as mesothoracic. Differing from both pro- and mesothoracic legs as follows: shorter but more prominent coxa; shorter but more prominent trochanter, which is produced subglobose entally; three prominent longitudinal ridges on tibia which are beset with rows of short bristles; one short, ectobasal and one middle spur; three relatively longer, closely apposed ectodistal spurs; and one long, stout, movable, entodistal spur; tarsus as long as tibia, three segmented, I about two-thirds total length of tarsus, five apposed, moderately long, ectodistal, and two entodistal spurs; II about one-half as long as I, four apposed ectodistal spines; III about as long as II.

Fore wing (pl. 1, fig. 10) elongately subelliptical, about three times as long as broad, extending beyond posterior end of abdomen, sparsely beset ectally along veins with whitish brown hairs; veins coarsely punctate with white dots; a broad, black, irregular, diffuse fascia along middle extending distally from humeral angle and becoming broader from subapex to apex; five brown spots bordering distal fourth of costal margin, apex and inner margin, between branches of longitudinal veins. Hind wing (pl. 1, fig. 11), membranous, uniformly hyaline, subtriangular, sparsely beset with very minute, almost inconspicuous hairs, about twice as long as broad, about two-thirds as long as fore wing, rounded at apex, broadly arcuate at inner margin.

Abdomen, subovate, about three-fifths total length of body, slightly broader than thorax, about two-thirds as long as broad, covered with numerous minute hairs, punctate; nine distinct segments; numerous lateral bristles at IV, V, and VI; the rest without. Pygofer thickly beset with hairs, especially along posterior margin, about two-thirds as long as broad and one-third as thick, strongly deflected dorsocaudally. Anal ring about

one-half as long and three-elevenths as thick as pygofer, broader posteriorly; anal style subellipsoidal, rounded apically, about one and one-half times as long as broad, inserted in anal ring by a peduncular process which is about two-thirds as broad as style. Aedeagus subconical, apex rounded, three acutely spiniform processes projecting from anterior end; about four times as long as broad, slightly smaller in diameter than anal style. Dorsal genital style about fifteen times as long as broad; a single subapical spine which describes with it an anteroventral angle of about 40° , acutely produced into a dorsally arcuate point, broad basally and acutely angulate distally (pl. 1, fig. 15).

Adult female (pl. 1, fig. 8). Length of body (exclusive of appendages) 4.42 millimeters; width 1.63; length of head 0.39; width 1.08; length of antenna 1.66; length of fore wing 4.87; width 1.39; length of hind wing 4.06; width 1.76.

The female is conspicuously larger than the male; lighter in color, especially in abdominal sternites, pro-, meso-, and metasterna, frons, clypeus, genae, labium and labrum, except at apex, which is dark brown. The large, black fascia, found on fore wing of male, absent, except small black spots intercepting distal ends of branches of longitudinal veins at costal margin; apex of wing, and inner margin. Anterior gonapophyses (pl. 1, fig. 16) about six and one-half times as long as distance at base, fuscous, horny, narrowly subfusiform, acutely angulate apically, slightly arcuate caudomesally, serrated at concave surface, except at base, inserted into more caudal abdominal sternite which telescopes into middle of fifth; a strongly deflected, laterocaudal, slightly attenuate, short extension basally at point of insertion. Posterior gonapophyses irregularly subgladiate, subunicolorous and thinner than anterior gonapophyses, very acutely pointed distally, about ten-elevenths as long, and one-fourth as broad, as anterior gonapophyses, about nineteen times as long as broad, closely apposed ectally to anterior gonapophyses. Sheath of ovipositor conspicuously lighter in color than gonapophyses, of uniform texture throughout, sublanceolate, acutely angulate distally, about fourteen times as long as width at base, about as long as anterior gonapophyses and about two-thirds as broad as distance at base of latter; a ventrocaudal mesal slit for protrusion of gonapophyses. Extension of gonapophyses-bearing, telescoping segment about two and one-half times as long as broad from ventral aspect. Anal segment about two-thirds as long as broad; numerous hairs ventrally; a caudal, vaguely subtrapezoidal extension, which is about one-half as long, and likewise as broad, as anal segment.

Fifth instar (pl. 1, fig. 6). Length of body (exclusive of appendages) 4 millimeters; width 1.38; length of head 0.32; width 0.98; length of antenna 1.37.

General color of body light brown, uniformly beset with very minute hairs. Similar to adult as follows: Prominence and arrangement of

carinae, characteristic markings, relative proportions of parts of legs, including bristles and spurs. Differing from adult as follows: five subcircular, punctiform depressions on either side near each anterolateral margin of pronotum; each depression circumscribed by subelliptical yellowish brown areas, which are arranged subregularly on a broad background of dark brown marginal band; one similar but smaller depression on either side of mesonotum, and three others near base of fore-wing pad, with neither circumscribing light area nor dark background. Tarsi of pro- and mesothoracic legs apparently two-segmented; those of metathoracic distinctly three-segmented. Fore-wing pad about four times as long as broad, subspatulate, rounded apically, emarginate at inner margin; dark brown spot at distal half, as in adult male. Hind-wing pad subtriangular, obtusely angulate apically, about three-fourths as long and about one and one-half times as broad as fore-wing pad, marked with irregular, diffuse, light brown spots. Two porrect, nearly parallel, subconical, posteriorly directed projections from ninth abdominal segment.

Fourth instar (pl. 1, fig. 5). Length of body (exclusive of appendages) 3.38 millimeters; width 1.22; length of head 0.31; width 0.92; length of antenna 1.17.

In characters of body and appendages, practically as in fifth instar.

Third instar (pl. 1, fig. 4). Length of body (exclusive of appendages) 2.76 millimeters; width 0.95; length of head 0.25; width 0.7; length of antenna 0.91.

Body light brown. Similar to later instars as follows: prominent carinae and markings of head, characteristic sensoria and bristles on antennae, subcircular, punctiform depressions of pronotum, characteristics of pro- and mesothoracic legs. Differing as follows: revolute marginal carinae of head bordering eyes not prominent, tarsi of metathoracic legs apparently two-segmented; tarsal segment I subcylindrical, with the same number of spurs as in fifth, about four times as long as broad and one and one-third times as long as II; II subconical, acutely angulate apically, about three and one-half times as long as broad. Fore-wing pad subtrapezoidal, outer margin emarginate; irregular diffuse spots, as in fifth instar; about one and one-half times as long as broad. Hind-wing pad irregularly subtrapezoidal, about as long as broad, margins straight, apex describing angle of about 50°, similar in markings to fifth instar. Abdominal markings as in fifth instar, but lighter and more restricted toward margins of tergites.

Second instar (pl. 1, fig. 3). Length of body (exclusive of appendages) 1.56 millimeters; width 0.55; length of head 0.2; width 0.32; length of antenna 0.48.

Body light brownish stramineous. Similar to later instars as follows: markings and circular depressions of pronotum, presence of movable spur at apex of metathoracic tibia, characteristics of pro- and mesothoracic legs. Metathoracic leg, as in third instar; tarsi apparently with two segments.

Differing from later instars as follows: cephalic carinae not prominent and not extending to posterior margin of head, abdominal markings, higher and more restricted toward lateral margins of tergites. Wing-pads not developed but their location marked by dark brown spots on meso- and metathoraces.

First instar (pl. 1, fig. 2). Length of body (exclusive of appendages) 0.92 millimeters; width 0.35; length of head 0.2; width 0.29; length of antenna 0.33.

Body opaque whitish stramineous. Similar to later instars as follows: characteristic antennal sensoria, which are, however, not prominent, sub-circular depressions of pronotum, presence of movable spur at apex of posterior tibia, uniformly two-segmented character of tarsi, and markings of pro-meso-, and metathoracic legs.

Wing pads absent, as in second instar. Spurs at proximal and middle portions of posterior tibia, which are characteristic of later instars, absent. Abdominal bristles absent. Carinae of head rudimentary.

Table for separation of nymphal instars

1. Wing pads present.....	2
Wing pads absent.....	3
2. Posterior tarsi distinctly three-segmented. Fore- and hind-wing pads subcoextensive apically.....	4
Posterior tarsi apparently two-segmented. Fore-wing pads extending to middle of costal margin of hind-wing pad. Length of body, exclusive of appendages, about 2 millimeters.....	Instar III
3. No spur at either proximal or middle portion of hind tibia. Length of body, exclusive of appendages, less than 1 millimeter.....	Instar I
A spur on ectoproximal and another at middle portion of hind tibia. Length of body slightly over 1.5 millimeter.....	Instar II
4. Length of body, exclusive of appendages, about 4 and usually more than 3.5 millimeters.....	Instar V
Length slightly over 3 millimeters, but less than 3.5 millimeters.....	Instar IV

Length of life cycle

The life history was determined on twenty-nine individual cultures. Lamp chimneys were used as breeding cages. Mass cultures in larger containers were used to check up results. Only the females were considered, although, of course, males were mated with them. The experiments were conducted during the period from August, 1925, to January, 1926, a total of about six months. This period was apparently the most favorable for *Perkinsiella*, as may be judged by examination of table 7a and 7b. The data for the life cycle are given in tables 1 and 1a.

It may be seen from these tables that the length of life cycle ranged from 32 to 66 days, with an average of 47.3 days. The maximum range does not appear to be an unusual extreme, since at least five of the cultures covered a period of over 60 days.

The period from emergence to first laying of eggs varied from 2 to 25 days; average 13.3 days.

Incubation period

Procedure. Fertilized adult females were kept in confinement on sugar cane and the dates of first oviposition and subsequently those of first egg hatching taken. The difference in the two dates in days is the incubation period of the eggs. The work covered the periods from September to December, 1925, and from January to May, 1926. No work on incubation was undertaken during June, July, and August, 1926, since no egg material in suitable quantities could be secured then. To determine the effect of environmental differences on duration of incubation period, the cultures were divided into three lots and treated as follows: .

(1) In confinement in the insectary. The cages were about two and one-half meters above the level of the ground. The moderately air-tight wooden floor of the building almost completely insulated the cultures from the ground. The data are given in tables 1 and 1a.

(2) In the field, under shade.

(3) In the field, exposed to sun.

The results are given in table 2.

It will be seen in table 1 that the period of incubation in the insectary varied from 11 to 23 days, with an average of 15.2 days. Table 2 shows that the average incubation period in the field in the open ranged from 10.5 to 19.5 days, with an average of 13.9 days, and in the shade, from 13.2 to 21 days with an average of 17.3 days. From these data it may be seen that the average incubation period in the open was the shortest, being 13.9 days; that in the insectary came next, with 15.2 days; and that under shade the longest, with 17.3 days. The probable explanation for these differences is that on account of direct exposure to sunlight the temperature in the open was higher than that in either the laboratory or in the field under shade. The temperature in the insectary was higher than under shade in the field because the windows were closed at night, which made the rooms quite warm.

The work was not carried far enough to determine the relation between climatic factors and duration of incubation period. It appears, however, from a superficial observation that the scarcity of eggs in the months of June, July, and August, 1926, was due, among other causes, to the prevailing high temperature and lack of rainfall in May. Two other important causes were the prevalence of effective egg parasites during that season and the condition of the cane tissue, which was then for the most part too old for the female's ovipositor to penetrate.

A comparison of the duration of the nymphal stadia and of the nymphal stage in the two sexes

The material on which the present observations were based consisted of fifty-two individual cultures, twenty-three of which were males and twenty-nine females. The lot included seven cultures previously used and

reported in table 1a. The work was carried on two partly overlapping generations, starting in August, 1925, and ending in January, 1926. This period covered approximately the same period as that in the life cycle experiments, which, as noted above, was apparently the most favorable part of the year for *Perkinsiella*. The results are given in table 3.

The figures given in table 3 do not seem to indicate that there are any significant differences in the duration of each of the five nymphal stadia between the two sexes. The average for the first stadium for all the cultures, irrespective of sex, is very slightly larger than that for the second. From the second to the fifth stadium there is a noticeable small progressive increase in the length of time between molts.

The male and female averages for the total length of the nymphal stage are about the same, but the maximum and minimum figures for the female are more than for the male. If these figures mean anything, they may be taken as showing that individually the female may require a relatively longer time to mature than the male, the low average being due to the fact that a proportionately larger number of individuals come closer to the minimum range.

Copulation

The sexually mature female which is ready to mate tilts the body upward by means of the hind legs. The male then approaches invariably from the left side, and at pairing the body describes anterosinistrally an angle of about 70° with that of the female. Copulation lasts about an hour or more. The process does not seem to interfere with feeding in either sex. After they separate each stretches the wings laterally as if to prepare for flight, but the action is followed only by walking to a near-by spot on the leaf suitable for feeding.

Manner of oviposition

The female usually selects a site away from the congregation of other leaf-hoppers where the leaf midrib or inner surface of sheath or stem is young and succulent and has not previously been used by others for oviposition. After locating a suitable place, it holds fast on the plant part by means of its claws and then secretes at the tip of the abdomen a clear fluid, which is probably a lubricant for the ovipositor. It apparently first feels by means of the distal end of the ovipositor for the most vulnerable part of the tissue. The ovipositor is then gradually thrust into the spot by an up and down movement, the egg-guide being buried deeper and deeper at each descent. It seems that the ultimate result of this action is to form underneath the plant epidermis a chamber which is sufficiently large to accommodate more than one egg. The number of eggs laid in each of these compartments is discussed later in the present paper.

Oviposition on the leaf midribs which are exposed is limited to the cooler parts of the morning and the afternoon; on the more protected inner

surfaces of leaf sheaths or on stems, the process may occur at any time of the day, even during the noon hours.

Number and position of eggs in the leaf

Objects. (1) To determine the total number of eggs present in each infested leaf; (2) number in each group as indicated by oviposition puncture in leaf; (3) position of eggs with respect to host tissue.

Procedure. Leaves bearing eggs were collected from the field and dissected in the laboratory.

Results. The results are given in tables 4 and 5.

It may be seen from tables 4 and 5 that from 1 to 4 eggs are present under each oviposition puncture, the average being 2.32.

From 6 to 1,836 eggs with an average of 439.4, were found in a single infested leaf. Of the two varieties considered, Badila bore the larger number of eggs to the leaf, with Luzon White having a relatively much smaller number.

The eggs were usually placed in the leaves at an angle of about 30° to 55° with the upper epidermis of the midrib. The concave sides of the eggs pointed in the same direction and were, as a rule, nearest the leaf surface (see pl. 1, fig. 18).

Feeding and other habits

The semigregarious habit of the insect has been noted in first part of the present paper. As many as one hundred individuals in all stages of growth have been counted on an infested leaf area. The nymphs predominate in number, the adults being relatively very few. The explanation of this condition may be that the eggs are laid in large batches on a given leaf or sheath area and the nymphs hatching therefrom do not wander very far in order to feed. The adults, on the other hand, may fly away and be carried by wind even to other cane plants. So firmly settled are the nymphs on the place where they are feeding that, if disturbed, they merely dodge the intrusion by a short run or jump and then return to their original location soon after they are left undisturbed. They usually select the more succulent leaves or softer leaf sheaths as their feeding areas.

When ready to molt, the young insect holds fast on the leaf surface by means of its claws and flexes the body ventrally. A dorsomesal rupture then appears from the head to the pronotum and the next instar breaks head first through the slit thus made.

The normal color is not restored until after a lapse of about six hours.

Number of generations during the year with a consideration of the effect of changes of climatic factors on duration of life cycle

The experiments were conducted in the field under two different conditions; namely, (1) in the shade, and (2) in the open. The work was begun

on September 6, 1925, and closed on September 7, 1926, covering a period of one year.

Four mass cultures were used in the shade and two in the open. In the shade, young canes transplanted in pots were used as breeding media and large Dietz-lantern chimneys covered over the top with cheese cloth as cages; in the open, canes growing on field plats and cages made of cheese cloth wrapped around bamboo frames.

The results are given in tables 6, 7a, 7b, and charts 1, 2, and 3.

On the basis of the results in the foregoing tables and charts the following conclusions are drawn:

1. Under artificial conditions, such as those in which the present experiments were conducted, five generations during the year were possible in the open and six in the shade.

2. The only months in which *Perkinsiella* could carry on its active generative cycles were: in the open, from July, 1925 until April of the year following, or a total of about nine months; in the shade from July, 1925 until June of the year following, or a total of about eleven months. Tables 7a and 7b begin the record in September, and not in August, since the former month was the time in which the insect began to appear in sufficiently abundant quantities for experimental work.

3. It was not possible to get any of the insects to live in confinement in the open during May, June, and July, 1926, and during July in confinement in the shade. In the field the number of *Perkinsiella* individuals began to decrease about the middle of March; in April, May, June, and July, none could be found among the plants visited; and the insect did not begin to reappear until about the middle of September. This condition was apparently brought about by the following causes:

- a. Protracted dryness in February, March, and April, 1926, and, to some extent, in May and June, evidently affected the food supply. The effect was more immediate in the open than under shade (chart 3).

- b. In March, April, May, and June, 1926, temperature was much higher than in other months under observation (chart 1) and the hot days came in more frequent succession. The maximum temperature for March was 31.4°C.; for April, 33.3°C.; for May, 33.5°C.; and for June, 30.3°C. The prevalence of hot weather in combination with scarcity of rainfall evidently brought about conditions unfavorable to *Perkinsiella*, by rendering the food supply inadequate, and in the open, through direct effect of protracted heat on the nymphs and adults. Moreover, the sugar cane plants during these months were, as a result of these untoward climatic factors, inhibited from producing young succulent tissues wherein eggs could be inserted, and oviposition was thus seriously hampered.

- c. The canes were then mature and ready to harvest.

- d. Natural enemies, particularly egg parasites, apparently decimated the host. As noted elsewhere in the present paper, they were abundant in Los Baños in November and December.

e. Relative humidity appeared to be highest during the period of greatest scarcity of *Perkinsiella* (chart 2).

4. The shortest average life cycle found was 39.5 days and the longest, 57.7.

5. Taking the period when the life cycle is the shortest as presumably the most favorable, it will be seen that the months of September and October, 1925, represented optimum conditions for carrying on the insect's vital activities. The heavy precipitation which began in July and continued through to this period, with the consequent effect on the host plant, and the relatively lower temperature prevailing then, apparently were the determining factors.

6. Correspondingly, January and February, 1926, apparently represented the most unfavorable months, the life cycle being relatively the longest then. These months represented the beginning of the dry season, when climatic factors, especially the rise in temperature, directly affected the insect and the scarcity of rainfall in conjunction with other environmental agencies exerted indirect influence on the insects mainly through bringing about changes in the host plant.

7. The effect of changes in climatic factors on the length of life cycle appeared to be more marked under shade than in the open. The probable explanation is that the host plants under shade had never been in the best of condition owing to inability to carry on photosynthesis normally. Under the circumstances they would be more readily susceptible to any additional untoward effect of the environment. The effect on the host became reflected on the insects which fed on them.

Natural enemies

Parasitic and predaceous insects, spiders, fungi, and other natural agents evidently play an important part in keeping down the number of *Perkinsiella vastatrix*. The following were met with in the course of the present investigation:

Egg parasites (endoparasites)

a. A species of Mymaridae (Hymenoptera)⁴

b. A species of Proctotrupidae (Hymenoptera)⁴ Egg predator.

A species of Capsidae (Hemiptera). This species punctures the egg shell and sucks the contents. Predaceous both in the nymphal and adult stages.

Ectoparasites on nymphs and adults.

Two apparently distinct species of mites.

These are probably of minor or no importance as natural control agents.

Endoparasites in nymphs and adults.

A species of entomophagous fungus.

Predators on nymphs and adults

⁴These insects have been sent abroad for identification.

a. *Proreus simulans* Stal. (Forficulidae, Dermaptera). Known also in British India. "Widely distributed in Oriental region." (Burr, 1910.)

b. *Chelisoches morio* Fabr. (Forficulidae, Dermaptera.) Terry (1905) notes that this "species has a wide distribution in the islands of the Pacific Ocean, and is recorded from Tahiti, Fiji, Hawaii, New Guinea, Java, Sumatra, Celebes, Philippines, Batchian, India, and Ceylon." This author gives complete descriptions of the four nymphal instars and the adult stage and also a general biological account.

c. *Paederus fuscipes* Curt. (Staphylinidae, Coleoptera.) This species is also known in Europe, where it is widely distributed (Harold, 1868).

d. Species of jumping spiders (Attidae).

The extent to which parasitism occurs was studied in detail in the present work in connection with the eggs of *Perkinsiella*. The results are given in table 8.

Table 8 shows that the percentage of parasitism of eggs by Mymarids varied from 17.68 to 98.63, with an average of 52.01. The egg parasites appeared in large numbers in the month of November, 1925. The adult Mymarids could be seen covering almost every new eggspot from early in the morning till about dark in the evening. This species of egg parasites also appeared in large numbers in November and December, 1926. It is evident that they are most abundant in November and December, although they are to be found in smaller numbers in other parts of the year whenever eggs of *Perkinsiella* are available.

Seasonal occurrence

Observations on the seasonal occurrence of *Perkinsiella* in the field were started in July, 1925, and carried through to January 16, 1927. At first only the Experiment Station grounds were covered, but, later on, the work was extended to other fields in the vicinity. The data are given in table 9.

Only monthly observations were made from July, 1925 to March, 1926, but thereafter weekly visits were made.

The following conclusions were drawn:

1. The month when greatest abundance of *Perkinsiella* nymphs and adults prevailed was November, 1925. As shown elsewhere in the present paper, the two months preceding, September and October, represented the period in which conditions were most favorable for *Perkinsiella* in carrying on its vital activities. It is not strange then that in November the insect was found to be most numerous. In certain fields, *Perkinsiella* was very abundant from October to January.

2. The severe typhoon in Los Baños on November 5, 1926, killed many of the insects, so that by December of that year they began to be scarce. *Perkinsiella*, however, previous to the typhoon, had been abundant at approximately the periods corresponding to those of 1925.

3. Natural enemies, particularly egg parasites, were abundant in November and December, 1925, and in November, 1926. This condition is to be expected, since the host was most abundant then.

4. In the two years, 1926 and 1927, *Perkinsiella* began to be scarce in January.

5. No *Perkiensiella* could be found in any of the fields visited in Los Baños and vicinity in March, 1926, and in the same month of 1927. It may be noted that possibly among the most important causes leading to its disappearance was that most of the canes were then too old for feeding and oviposition. Harvesting time in Los Baños is generally in February and March.

6. In 1926, the insect began first to appear in noticeable quantities in September. This was three months later than the first appearance in 1925, which was in July. The probable immediate cause is the longer and hotter dry season in 1926.

Relative degrees of susceptibility of different cane varieties in Los Baños

Observations were made weekly, on either Saturday or Sunday, from January 7, 1926, when new plantings were set out by the Plant Breeding Division, to October 30, 1926. The work could not be carried on after this date, as nearly all the plants were destroyed by typhoon on November 5, 1926.

The following terms were used in evaluating degrees of susceptibility of the different varieties.

1. *Light infestation*—each cane leaf with not more than one hundred egg spots.

2. *Medium infestation*—each cane leaf with over one hundred, but not more than three hundred, egg spots.

3. *Heavy infestation*—around six hundred egg spots to each leaf.

4. *Very heavy infestation*—cane very heavily attacked; so much so that even stems bore egg spots.

Examining table 10, it may be seen that Uba, H 109, Toledo, Morado. D. I. 52, C. A. C. 87, P. B. 68, and P. B. 94 are subject to light infestation. These varieties were found to be relatively the least susceptible to the attack of the pest in all stages of growth through the entire period of observation. Cebu Purple, C. A. 18156, Variation of Striped Tanna, P. B. 158, P. B. 117 were under medium infestation, except the last, which at first was heavily infested but later on became less so as the other varieties became available.

The infestation on Pampanga Purple, Luzon White, Luzon Striped, Negros Purple, P. B. 119, 124, 142, 148, seedlings of P. B. 121, C. A. N, 18158, 18159, Java 247 came gradually, light at first, then increased progressively until heavy infestation was reached. Pampanga Purple Striped, which is a bud sport of Pampanga Purple, and Badila were found to be very heavily infested from the beginning.

The foregoing data indicate that, other things being equal, there are cane varieties which promise to be relatively less susceptible to *Perkinsiella* infestation than others. Further work along these lines should be done to establish the varieties best suited to grow in heavily attacked regions.

SUMMARY AND CONCLUSIONS

1. *Perkinsiella vastatrix* Breddin (1896), Delphacidae, Delphacini (Homoptera), is one of the relatively important pests of sugar cane in the Philippine Islands.

2. The insect is apparently confined to the Oriental Region and a small part of the Palaearctic (Japan only).

3. It is probably autochthonous in the Philippine Islands, in common with other Oriental countries.

4. Sugar cane is the only known host of this insect in the Philippines. Since this plant is an introduced species in this country the original host was presumably some wild native grass, probably the talahib, *Saccharum spontaneum* subsp. *indicum* Hack. It appears, however, that since the arrival of the sugar cane, this plant has become the preferred host to the exclusion of all others.

5. The injury to the cane consists of lesions in the upper surface of leaf midribs or leaf sheaths, and to a lesser degree, in stems resulting from feeding by nymphs, as well as adults, and from oviposition. The work of the insect is often followed by secondary complications, such as invasion through the wounds by pathogenic microorganisms.

6. Sugar cane generally begins to become susceptible to the attack of the pest when it begins to stool about one and one-half months from plant cane and about four months from ratooning. Very old canes which are ready to harvest are relatively free from attack.

7. Descriptions of the egg and the different postembryonic instars are given.

8. The life cycle ranged as follows: individual, 32 to 66 days; average 39.5 to 57.7 days. In the present work the shortest average life cycle was found to occur in September and October, 1925; the longest, in January and February, 1926.

9. Copulation lasts about one hour or more.

10. The time elapsing from emergence of adult female to first oviposition was 2 to 25 days; average, 13.3.

11. Each infested leaf was found to contain a total of from 6 to 1,836 eggs; average, 439.4.

12. In each egg chamber, underneath the oviposition puncture in the leaf, there were found from 1 to 4 eggs; average, 2.32.

13. Incubation period of the eggs in the open was from 10.5 to 19.5 days; average, 13.9 days; in the shade, 13.2 to 21; average, 17.3.

14. There are five nymphal instars, the fifth molt marking the transition to the adult stage.

15. The nymphs and adults are semigregarious. The nymphs are practically stationary on one feeding area; the adults usually fly away and with the aid of the wind migrate to another part of the same plant or to other plants.

16. During the period covered by the present experiments there were in one year's time five generations in the open and six in the shade.

17. The insect could apparently pass through active generative cycles during only a part of the year; the rest of the time it was probably in some dormant stage which the present observations failed to establish.

18. The favorable growing months were from July, 1925, to April, 1926, or a total of about nine months in the open; and from July, 1925, to June, 1926, or a total of about eleven months in the shade. The insect could not be made to live in confinement in the open in May, June, and July, 1926, and in the shade in July, 1926.

19. In nature, *Perkinsiella* was most abundant in November, 1925, following the favorable growing months of September and October. It began to decrease in number in January, 1926, and in March began to be extremely scarce. It may be noted in this connection that apparently the most unfavorable growing months, wherein life cycle was longest during the year, were January and February. No *Perkinsiella* could be found in any stage in the fields visited in May, June, and July, 1926. The insect first began to reappear in noticeable quantities in September. Several causes may be adduced for this suspension of vital activities, most important among which were protracted dryness during those months in combination with high relative humidity; condition of the cane plants, which were then mature and ready to harvest, so that the tissues were too tough for piercing, both in feeding and in oviposition; and as an after effect of the prevalence of natural enemies previously in November and December, 1925.

20. Climatic factors apparently produced a more telling effect on the insect in the shade than in the open.

21. In the severe typhoon of November 5, 1926, many of the insects were beaten to death, so that by December they began to be scarce.

22. The following natural enemies were found: Two species of egg endoparasites, one species of egg predator, one species of entomophagous fungus infecting nymphs and adults, and four species of predators on nymphs or adults. Of these natural enemies the most effective was apparently a Mymarid, which parasitized the eggs to the extent of from 17.68 to 98.63 per cent; average, 52.00 per cent.

23. Different varieties of sugar cane exhibited varying degrees of susceptibility to the attack of *Perkinsiella*. In the present work, the following varieties were found to be least damaged: Uba, H 109, Toledo,

Morado, D. I. 52, C.A.C. 87, P. B. 68, and P. B. 94. Most heavily infested: Pampanga Purple striped and Badila.

24. On the basis of the results obtained in the present work the following control measures are tentatively suggested, pending more thorough investigation along these lines:

- a. Planting of resistant or relatively less susceptible varieties.
- b. Encouragement of natural enemies. If conditions warrant, reinforcement of existing native natural enemies by importation and colonization of exotic species.
- c. Rotation of crops would not be advisable unless the practice could be coördinated and made general over large areas. Since *Perkinsiella* is apparently a monophagous, or at most oligophagous, pest, almost any crop may follow sugar cane in rotation, the only possible exceptions being sorghum and corn.
- d. Regulation of the time of planting is not deemed practicable, since sugar cane is susceptible to attack over a long period during its life—eight months or over—and *Perkinsiella* is scarce or wanting in active stages during only about four months.

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ILLUSTRATIONS

(Magnifications indicated refer to size of original figures)

PLATE 1

- Fig. 1. Egg of *Perkinsiella vastatrix*, $\times 120$
2. Nymph, first instar, dorsal view, $\times 36.5$
3. Nymph, second instar, dorsal view, $\times 36.5$
4. Nymph, third instar, dorsal view, $\times 36.5$
5. Nymph, fourth instar, dorsal view, $\times 36.5$
6. Nymph, fifth instar, dorsal view, $\times 36.5$
7. Adult male, dorsal view, $\times 30$
8. Adult female, dorsal view, $\times 30$
9. Head of male, frontal view, $\times 91.6$
10. Right fore wing of male, dorsal view, $\times 36.5$
11. Right hind wing of male, dorsal view, $\times 36.5$
12. Right prothoracic leg of male, $\times 58.3$
13. Right mesothoracic leg of male, $\times 58.3$
14. Right metathoracic leg of male, $\times 58.3$
15. Male genitalia, $\times 120$
16. Female genitalia, $\times 77$
17. Right antenna of male, $\times 176$
18. Eggs *in situ* in dissected leaf midrib (semi-diagrammatic), $\times 15$

PLATE 2

- Fig. 1. Sugar cane leaf sheaths (left) and stem (right) showing damage from oviposition by *Perkinsiella*.
Fig. 2. Sugar cane leaves showing damage on midribs from oviposition by *Perkinsiella*.

TABLE 1

Life cycle of Perkinsiella vastatrix, female (under laboratory conditions)

CULTURE NO.	EGGS HATCHED	ADULTS EMERGED	DURATION OF NYMPHAL STAGE	EGGS LAID	PERIOD FROM EMERGENCE TO FIRST LAYING OF EGGS	EGGS HATCHED	PERIOD OF INCUBATION	LENGTH OF LIFE CYCLE
	1925	1925	days	1925	days	1925	days	days
2	14-VIII	4-IX	21	29-IX	25	18-X	20	66
3	15-VIII	4-IX	20	9-IX	15	24-IX	15	39
4	15-VIII	3-IX	19	8-IX	4	26-IX	18	42
5	15-VIII	29-VIII	14	6-IX	8	18-IX	12	34
6	15-VIII	29-VIII	14	6-IX	8	18-IX	12	34
7	15-VIII	3-IX	19	6-IX	3	18-IX	12	34
8	15-VIII	2-IX	18	6-IX	4	18-IX	12	34
9	16-VIII	6-IX	21	15-IX	9	2-IX	18	48
11	16-VIII	3-IX	18	6-IX	4	18-IX	12	33
13	16-VIII	2-IX	17	6-IX	3	23-IX	17	38
16	19-VIII	9-IX	21	18-IX	9	7-IX	20	50
17	19-VIII	5-IX	17	11-IX	6	29-IX	18	41
19	28-VIII	14-IX	17	18-IX	4	30-IX	12	34
20	29-VIII	15-IX	17	18-IX	3	30-IX	12	32
21	29-VIII	15-IX	17	28-IX	13	15-X	18	48
22	29-VIII	16-IX	18	18-IX	2	30-IX	12	32
23	30-VIII	19-IX	20	3-IX	15	21-X	18	53
				1926		1926		
27	3-XII	29-XII	26	14-I	16	2-II	19	61
28	3-XII	30-XII	27	14-I	15	2-II	19	61
30	6-XII	27-XII	21	15-I	19	7-II	23	63
32	6-XII	1-I-'26	26	16-I	15	6-II	21	62
38	8-XII	27-XII	19	15-I	19	3-II	19	57
carried from table 1a								
23a	—	—	20	—	25	—	13	58
24a	—	—	20	—	24	—	13	57
25a	—	—	17	—	23	—	12	52
26a	—	—	22	—	19	—	12	53
27a	—	—	21	—	22	—	12	55
28a	—	—	18	—	23	—	11	52
29a	—	—	17	—	23	—	11	51
Maximum	—	—	27	—	25	—	23	66
Minimum	—	—	14	—	2	—	11	32
Average	—	—	19.3	—	13.3	—	15.2	47.3

TABLE 1a

Life cycle of Perkinsiella vastatrix, female (under laboratory conditions)

CULTURE NO.	EGGS LAID	EGGS HATCHED	PERIOD OF INCUBATION	ADULTS EMERGED	DURATION OF NYMPHAL STAGE	EGGS LAID	PERIOD FROM EMERGENCE TO FIRST LAYING OF EGGS	LENGTH OF LIFE CYCLE
	1925	1925	days	1925	days	1926	days	days
23a	20-XI	3-XII	13	23-XII	20	17-I	25	58
24a	20-XI	3-XII	13	23-XII	20	16-I	24	57
25a	25-XI	7-XII	12	24-XII	17	16-I	23	52
26a	26-XI	8-XII	12	30-XII	22	18-I	19	53
27a	26-XI	8-XII	12	29-XII	21	20-I	22	55
28a	26-XI	7-XII	11	25-XII	18	17-I	23	52
29a	27-XI	8-XII	11	25-XII	17	17-I	23	51

TABLE 2

Incubation period (field experiment)

	LOTS IN THE OPEN			LOTS IN THE SHADE				
	I	II	Average	I	II	III	IV	Average
	1925	1925	days	1925	1925	1925	1925	days
Eggs laid.....	7-IX	6-IX	—	7-IX	7-IX	7-IX	7-IX	—
Hatched.....	23-IX	18-IX	—	23-IX	23-IX	23-IX	23-IX	—
Incubation period	16 days	12 days	14.0	16 days	16 days	16 days	16 days	16.0
Eggs laid.....	19-X	13-X	—	19-X	19-X	19-X	19-X	—
Hatched.....	3-XI	19-IX	—	2-XI	2-XI	2-XI	2-XI	—
Incubation period	15 days	6 days	10.5	14 days	14 days	15 days	14 days	14.2
Eggs laid.....	1-XII	2-XII	—	2-XII	2-XII	3-XII	2-XII	—
Hatched.....	12-XII	15-XII	—	22-XII	23-XII	23-XII	25-XII	—
Incubation period	11 days	13 days	12.0	20 days	21 days	20 days	23 days	21.0
	1926	1926		1926	1926	1926	1926	
Eggs laid.....	20-I	15-I	—	23-I	30-I	30-I	2-II	—
Hatched.....	3-II	28-I	—	7-II	12-II	13-II	14-II	—
Incubation period	14 days	13 days	13.5	15 days	13 days	14 days	12 days	13.5
Eggs laid.....	9-III	5-III	—	18-III	23-III	22-III	24-III	—
Hatched.....	27-III	26-III	—	5-IV	6-IV	6-IV	6-IV	—
Incubation period	18 days ^a	21 days ^a	19.5	18 days	17 days	15 days	13 days	13.2
Eggs laid.....	—	—	—	9-V	10-V	12-V ^b	12-V	—
Hatched.....	—	—	—	24-V	25-V	—	26-V	—
Incubation period	—	—	—	15 days ^a	15 days ^a	—	14 days ^a	14.5
Maximum.....	—	—	19.5	—	—	—	—	21.0
Minimum.....	—	—	10.5	—	—	—	—	13.2
Average.....	—	—	13.9	—	—	—	—	17.3

^a Only few eggs were hatched.^b Eggs were not hatched.

NUMBER	SE
1	ma
2	fen
3	fen
4	fen
5	fen
6	fer
7	fer
8	fer
9	fer
10	ma
11	fer
12	ma
13	fer
14	ma
15	ma
16	fe
17	fe
18	m
19	fe
20	fe

51	4-A1	1	MINIMUM	—	1
52	2-XI	2	Average	—	2

TABLE 4

Number of eggs under each oviposition puncture in leaf

PUNCTURE NUMBER	DATE	NUMBER OF EGGS
	1926	
1	2-XI	4
2	2-XI	1
3	2-XI	3
4	2-XI	2
5	2-XI	4
6	2-XI	3
7	2-XI	3
8	2-XI	3
9	2-XI	3
10	2-XI	3
11	2-XI	2
12	2-XI	3
13	2-XI	4
14	2-XI	3
15	2-XI	4
16	2-XI	3
17	2-XI	2
18	2-XI	4
19	2-XI	3
20	2-XI	4
21	2-XI	2
22	2-XI	3
23	2-XI	4
24	2-XI	2
25	2-XI	2
26	2-XI	2
27	2-XI	2
28	2-XI	1
29	2-XI	3
30	2-XI	2
31	2-XI	2
32	2-XI	1
33	2-XI	3
34	2-XI	2
35	2-XI	4
36	2-XI	3
37	2-XI	3
38	2-XI	1
39	2-XI	1
40	2-XI	3
41	2-XI	4
42	2-XI	1
43	2-XI	1
44	2-XI	1
45	2-XI	3
46	2-XI	2
47	2-XI	1
48	2-XI	3
49	2-XI	2
50	2-XI	2
51	2-XI	1
52	2-XI	2

TABLE 4—Continued

Number of eggs under each oviposition puncture in leaf

PUNCTURE NUMBER	DATE	NUMBER OF EGGS
	1926	
53	2-XI	1
54	2-XI	3
55	2-XI	1
56	2-XI	1
57	2-XI	3
58	2-XI	1
59	2-XI	4
60	2-XI	3
61	2-XI	3
62	2-XI	1
63	2-XI	3
64	2-XI	3
65	2-XI	2
66	2-XI	1
67	2-XI	1
68	2-XI	1
69	2-XI	3
70	2-XI	1
71	2-XI	2
72	2-XI	1
73	2-XI	1
74	2-XI	1
75	2-XI	2
76	2-XI	2
77	2-XI	1
78	2-XI	2
79	2-XI	2
80	2-XI	1
81	2-XI	2
82	2-XI	3
83	2-XI	2
84	2-XI	3
85	2-XI	4
86	2-XI	2
87	2-XI	4
88	2-XI	2
89	2-XI	2
90	2-XI	4
91	2-XI	2
92	2-XI	2
93	2-XI	1
94	2-XI	3
95	2-XI	1
96	2-XI	2
97	2-XI	3
98	2-XI	2
99	2-XI	3
100	2-XI	3
Maximum	—	4
Minimum	—	1
Average	—	2.32

TABLE 5

TABLE 5—Continued

*Number of eggs in each leaf, including sheath**Number of eggs in each leaf, including sheath*

LEAF NUMBER	DATE	SUGAR CANE VARIETY USED	NUMBER OF EGGS	LEAF NUMBER	DATE	SUGAR CANE VARIETY USED	NUMBER OF EGGS
	1925				1926		
1	August	Luzon White	12	52	10-XII	Luzon White	310
2	"	"	24	53	10-XII	"	306
3	"	"	20	54	10-XII	"	299
4	"	"	14	55	10-XII	"	252
5	"	"	6	56	10-XII	"	331
6	"	"	10	57	11-XII	"	299
7	"	"	24	58	11-XII	"	505
8	"	"	14	59	11-XII	"	273
9	"	"	24	60	11-XII	"	549
10	"	"	20	61	11-XII	"	329
11	"	"	4	62	11-XII	"	194
12	"	"	20	63	11-XII	"	213
13	"	"	18	64	11-XII	"	303
14	"	"	30	65	11-XII	"	213
15	"	"	18	66	11-XII	"	354
16	"	"	15	67	11-XII	"	201
17	"	"	39	68	11-XII	"	241
18	"	"	20	69	11-XII	"	294
19	"	"	36	70	11-XII	"	238
20	"	"	32	71	11-XII	"	136
21	"	"	28	72	11-XII	"	198
22	"	"	15	73	11-XII	"	401
23	"	"	12	74	11-XII	"	331
24	"	"	30	75	11-XII	"	283
25	"	"	21	76	11-XII	"	677
26	"	"	20	77	11-XII	"	561
	1926			78	11-XII	"	132
27	14-XI	Badilla	1016	79	11-XII	"	180
28	14-XI	"	1213	80	11-XII	"	343
29	14-XI	"	1074	81	11-XII	"	495
30	14-XI	"	1572	82	11-XII	"	610
31	14-XI	"	1104	83	11-XII	"	296
32	14-XI	"	1373	84	11-XII	"	546
33	14-XI	"	1612	85	11-XII	"	399
34	14-XI	"	897	86	11-XII	"	395
35	14-XI	"	1836	87	11-XII	"	180
36	14-XI	"	988	88	11-XII	"	215
37	14-XI	"	793	89	11-XII	"	132
38	14-XI	"	1014	90	11-XII	"	192
39	14-XI	"	1239	91	11-XII	"	97
40	14-XI	"	760	92	11-XII	"	296
41	14-XI	"	1076	93	11-XII	"	120
42	14-XI	"	921	94	11-XII	"	415
43	14-XI	"	941	95	11-XII	"	155
44	14-XI	"	1521	96	11-XII	"	201
45	14-XI	"	1141	97	11-XII	"	387
46	14-XI	"	749	98	11-XII	"	167
47	14-XI	"	1108	99	11-XII	"	619
48	14-XI	"	756	100	11-XII	"	559
49	14-XI	"	1339	Maximum	—	—	1836
50	14-XI	"	806	Minimum	—	—	4
51	14-XI	"	1143	Average	—	—	439.4

TABLE 6
Monthly weather observations^a

MONTHS	TEMPERATURE			HUMIDITY	RAINFALL
	Max.	Min.	Mean		
1925	°C.	°C.	°C.	per cent	mm.
August.....	29.2	23.3	26.2	79.0	417.6
September.....	28.6	22.8	25.7	79.0	183.3
October.....	28.0	22.4	25.2	81.6	386.3
November.....	27.9	22.8	25.3	77.0	147.9
December.....	26.7	21.4	24.0	75.0	71.9
1926					
January.....	27.2	21.5	24.3	75.3	43.8
February.....	27.9	21.4	24.7	76.0	5.9
March.....	31.4	22.0	26.7	77.8	11.2
April.....	33.3	23.6	28.5	75.2	00.0
May.....	33.5	23.6	28.5	76.2	55.3
June.....	30.3	24.3	27.3	80.9	85.0
July.....	26.7	24.2	25.4	85.2	291.6
August.....	26.4	23.8	25.1	78.8	270.8
September.....	29.1	23.7	26.5	79.7	217.0
October.....	29.9	24.1	27.0	79.2	123.3
November.....	28.8	23.8	26.3	79.0	186.1
December.....	29.1	23.3	26.2	79.6	61.5

^aCompiled from the records of the Department of Plant Physiology.

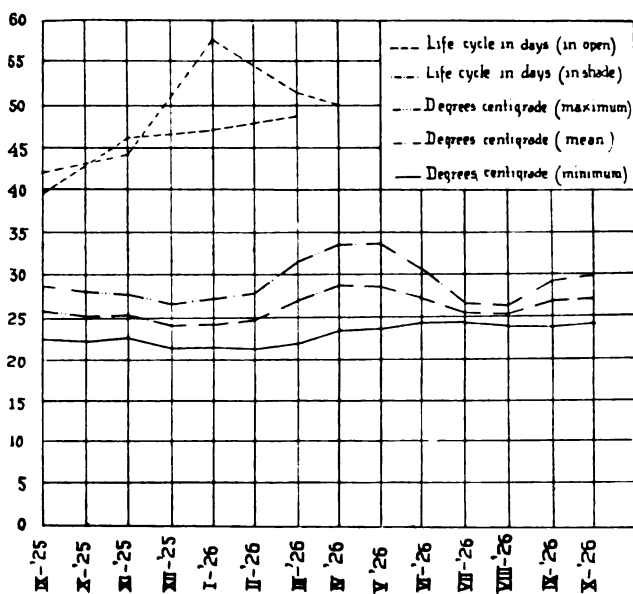


Chart 1.—Relation of length of life cycle to temperature variations (based on tables 6, 7a, and 7b).

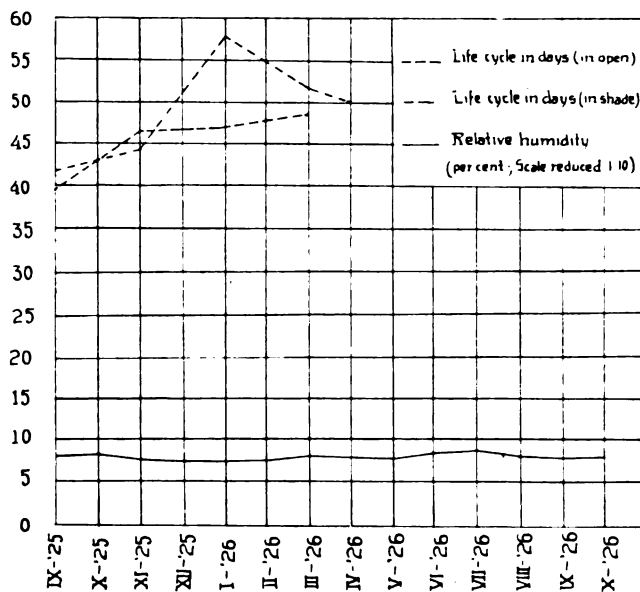


Chart 2.—Relation of length of life cycle to relative humidity (based on tables 6, 7a, and 7b).

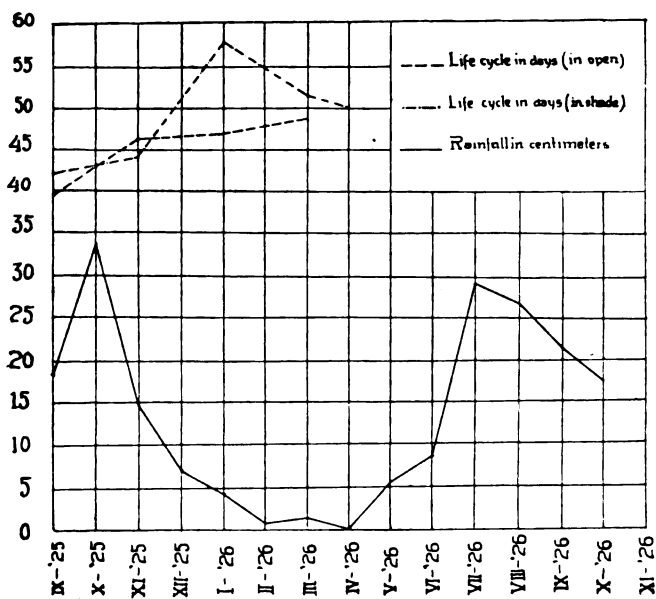


Chart 3.—Relation of length of life cycle to rainfall
(based on tables 6, 7a, and 7b).

TABLE 7a
Number of generations in shade in one year

	LOTS				AVERAGE LENGTH OF LIFE CYCLE
	I	II	III	IV	
	1925	1925	1925	1925	days
		<i>First generation</i>			
Eggs laid.....	7-IX	7-IX	7-IX	7-IX	
Eggs hatched.....	23-IX	23-IX	23-IX	23-IX	
Adult emerged.....	11-X	11-X	12-X	11-X	42.0
Eggs laid.....	19-X	19-X	19-X	19-X	
Total life cycle.....	42 days	42 days	42 days	42 days	
		<i>Second generation</i>			
Eggs laid.....	2-XI	2-XI	3-XI	2-XI	
Adult emerged.....	19-XI	19-XI	22-XI	22-XI	44.2
Eggs laid.....	2-XII	2-XII	3-XII	2-XII	
Total life cycle.....	44 days	44 days	45 days	44 days	
		<i>Third generation</i>			
Eggs laid.....	22-XII	23-XII	23-XII	25-XII	
	1926	1926	1926	1926	
Adults emerged.....	16-I	28-I	29-I	24-I	
Eggs laid.....	23-I	30-I	30-I	2-II	57.7
Total life cycle.....	52 days	59 days	58 days	62 days	
		<i>Fourth generation</i>			
Eggs laid.....	7-II	12-II	13-II	14-II	
Adults emerged.....	28-II	29-II	4-III	7-III	51.7
Eggs laid.....	18-III	23-III	22-III	24-III	
Total life cycle.....	54 days	52 days	51 days	50 days	
		<i>Fifth generation</i>			
Eggs laid.....	5-IV	6-IV	6-IV	6-IV	
Adults emerged.....	3-V	2-V	1-V	3-V	50.0
Eggs laid.....	9-V	10-V	12-V	12-V	
Total life cycle.....	52 days	48 days	51 days	49 days	
		<i>Sixth generation</i>			
Egg laid.....	24-V	25-V	Not hatched	26-V	
Adults emerged.....	15-VI	14-VI	—	All female died	
	No eggs laid (died)				

TABLE 7b

Number of generations in the open in one year

	LOTS		AVERAGE LENGTH OF LIFE CYCLE
	I	II	
	1925	1925	
	<i>First generation</i>		
Eggs laid.....	7-IX	6-IX	39.5
Eggs hatched.....	23-IX	18-IX	
Adults emerged.....	11-X	10-X	
Eggs laid.....	19-X	13-X	
Total life cycle.....	42 days	37 days	
	<i>Second generation</i>		
Eggs laid.....	3-XI	19-X	46.5
Adults emerged.....	20-XI	20-XI	
Eggs laid.....	1-XII	2-XII	
Total life cycle.....	43 days	50 days	
	<i>Third generation</i>		
Eggs laid.....	12-XII	15-XII	47.0
Adults emerged.....	29-XII	30-XII	
	1926	1926	
Eggs laid.....	20-I	15-I	
Total life cycle.....	50 days	44 days	
	<i>Fourth generation</i>		
Eggs laid.....	3-II	28-I	48.5
Adults emerged.....	4-III	28-II	
Eggs laid.....	9-III	5-III	
Total life cycle.....	48 days	49 days	
	<i>Fifth generation</i>		
Eggs laid.....	27-III	26-III	
Adults emerged.....	12-IV	all died	
	all died		

TABLE 8

Degree of parasitism

EXPERIMENT NO.	DATE	TOTAL NUMBER OF EGGS IN LOT	PARASITIZED EGGS	PERCENTAGE OF PARASITISM
1926				
1	30-XI	71	24	33.80
2	30-XI	103	49	47.57
3	30-XI	29	10	34.48
4	30-XI	36	15	41.66
5	30-XI	56	20	35.71
6	30-XI	19	8	42.10
7	30-XI	25	8	32.00
8	30-XI	22	6	27.27
9	30-XI	17	7	41.17
10	30-XI	21	5	23.80
11	30-XI	15	6	40.00
12	30-XI	30	15	50.00
13	30-XI	17	7	41.17
14	30-XI	15	7	46.66
15	30-XI	18	6	33.33
16	30-XI	28	5	17.86
17	30-XI	21	6	28.57
18	30-XI	19	11	57.89
19	30-XI	14	5	35.71
20	30-XI	47	19	40.42
21	30-XI	31	8	25.80
22	30-XI	75	26	34.66
23	30-XI	46	18	39.13
24	30-XI	63	16	25.39
25	30-XI	64	23	35.93
26	5-XII	176	92	52.27
27	5-XII	98	67	68.36
28	5-XII	103	49	47.57
29	5-XII	127	93	73.22
30	5-XII	176	144	81.81
31	5-XII	298	189	63.42
32	5-XII	273	204	74.12
33	5-XII	326	239	73.31
34	6-XII	238	184	77.31
35	6-XII	96	92	95.83
36	6-XII	73	72	98.63
37	6-XII	219	203	92.69
38	6-XII	346	328	94.79
39	6-XII	123	98	79.67
40	6-XII	362	314	86.74
41	9-XII	76	45	59.21
42	9-XII	129	54	41.86
43	10-XII	89	53	59.55
44	10-XII	74	41	55.40
45	10-XII	57	32	56.14
46	10-XII	68	38	55.88
47	10-XII	113	66	58.40
48	10-XII	109	37	33.94
49	10-XII	52	27	51.92
50	10-XII	50	28	56.00
Maximum*	—	362	328	98.63
Minimum	—	14	5	17.86
Average	—	95.06	62.38	52.01

Average 95 06 62 38 52 01

TABLE 10

Degree of susceptibility of different cane varieties in Los Baños

DATE OF PLANTING	DATE OF LAST OBSERVATION	AGE AT LAST OBSERVATION	LIGHT INFESTATION	MEDIUM INFESTATION	HEAVY INFESTATION	VERY HEAVY INFESTATION
1926	1926	days	variety	variety	variety	variety
7-I	30-X	296	Uba	Cebu Purple	Pampanga Purple	
7-I	30-X	296	H109	C.A.N. 18156 (Cagayan Striped)	Luzon White	
7-I	30-X	296			Luzon Striped ^a	
7-I	30-X	296			Negros Purple	
2-II	30-X	270	Toledo	Variation of striped Tanna		
2-II	30-X	270	Morado			
2-II	30-X	270	D.I. 52			
15-IV	30-X	198				Pampanga Purple Striped ^b
24-IV	30-X	189		P.B. 158		
28-IV	30-X	185			P.B. 124	
3-V	30-X	180			P.B. 142	
3-V	30-X	180			Java 247	
18-V	30-X	165	C.A.C. 87			
20-V	30-X	163	P.B. 68		P.B. 148	
20-V	30-X	163	P.B. 94			
26-V	30-X	157		P.B. 117 ^c		
27-V	30-X	156				Badila
30-V	30-X	153			C.A.N. 18158 (Cagayan Purple)	
8-VI	30-X	144			Negros Purple Seedlings	
15-VI	30-X	137			P.B. 119 ^a	
9-VII	30-X	113			C.A.N. 18159 (Cagayan White)	
7-VIII	30-X	84			Seedlings of P.B. 121	

^a Bud sport of Luzon White.^b Bud sport of Pampanga Purple.^c Seedlings of Badila.

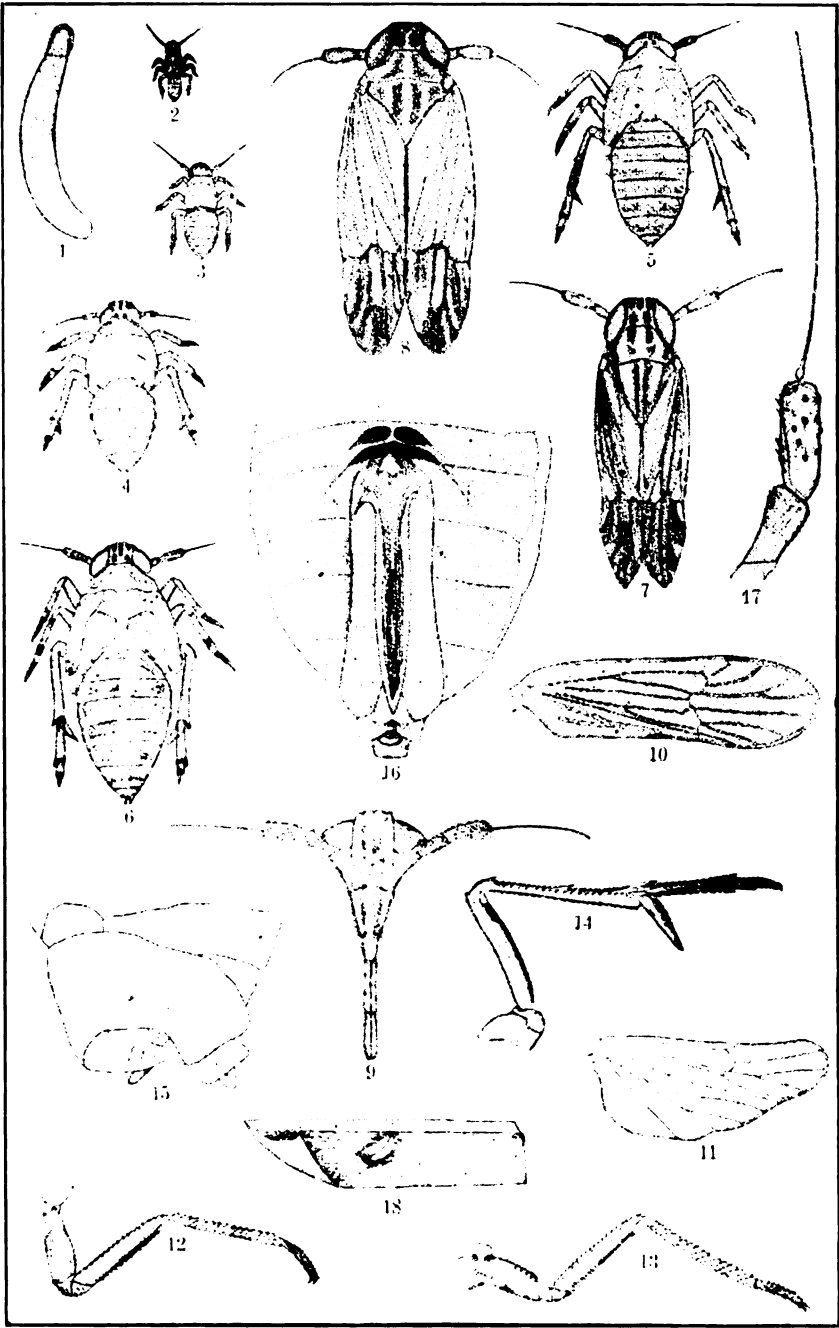


PLATE 1

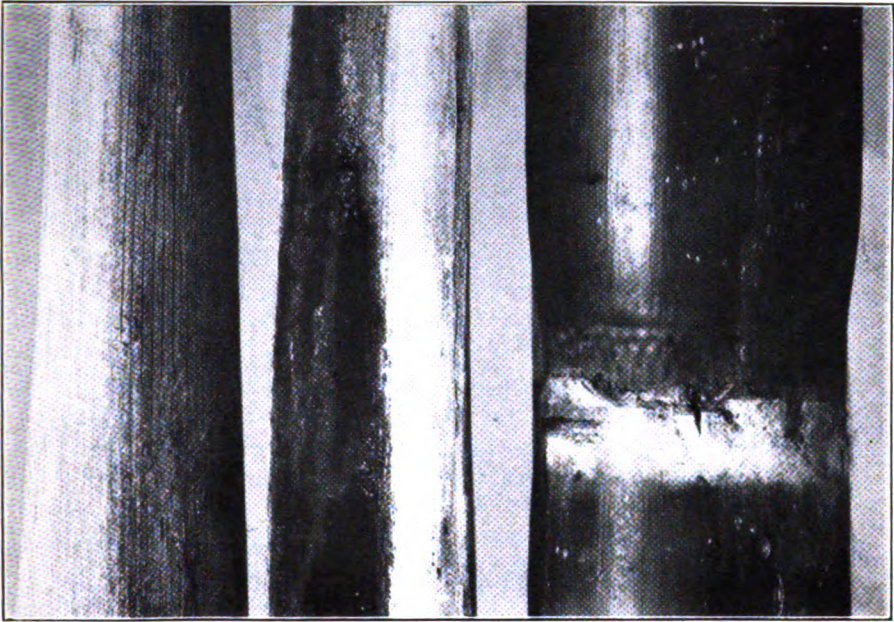


Fig. 1



Fig. 2

PLATE II

THE POSSIBILITIES OF CASSAVA PRODUCTION IN THE PHILIPPINES¹

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Of the Department of Agricultural Chemistry

As it grows wild in many sections in the Islands, most Filipinos are acquainted with camoteng cahoy, (*Manihot utilissima*), also known as cassava and manioc. Perhaps their first acquaintance with this plant was in childhood through the classical *suman* made from its flour. As familiarity breeds contempt, so we consider this plant good only as a famine crop and for making sweetmeats and confectionery for special occasions. Lately, however, our attention has been attracted to cassava on account of our large importation of starch from China, the British and Dutch East Indies, and the United States. To give an idea of the amount of these importations, the following figures from the 1923 and 1925 Statistical Bulletins of the Bureau of Commerce and Industry and the 1926 Annual Report of the Insular Collector of Customs are quoted:

TABLE 1
Value in pesos of starch importation into the Philippines

YEAR	BRITISH EAST INDIES	CHINA	DUTCH EAST INDIES	UNITED STATES	TOTAL
1920.....	36,287	44,614	42,980	—	123,881
1921.....	15,488	273,285	29,504	—	318,277
1922.....	21,818	297,947	142,504	—	461,858
1923.....	53,756	215,503	289,324	—	558,583
1924.....	6,763	101,416	462,568	—	570,747
1925.....	6,394	63,552	426,306	40,985	540,237
1926.....	7,555	59,322	470,491	53,457	590,825

The greater part of this starch is sold for laundry use under the name of *gaw-gaw*. Table 1 shows that since 1920 our importation of this product has increased yearly until in 1926 starch worth over ₱590,000 was imported.

Considering the nature of the plant and its cultivation, is there any reason that our supply should not be grown in our own country? A few statements on cassava cultivation will show that apparently there is none:

1. Cassava is a very easy plant to grow under most field crop conditions in the Philippines.

¹Experiment Station contribution No. 469. Revised and condensed for publication from an article read by Dr. Manuel L. Roxas in 1925 before the Philippine Society of Technical Agriculturists, at the College of Agriculture, Los Baños, P. I.

2. There is an exact parallel between the planting and cultivation of sugar cane and cassava. Both produce after one year. Both are propagated by cuttings. Both produce a carbohydrate.

3. Cassava has many advantages over sugar cane which few people seem to realize. In the first place, cassava may be propagated more rapidly than sugar cane as more cuttings can be made from the stem than from the sugar cane plant, since cassava cuttings are obtained from the base up, while in sugar cane usually only the top is used. In the second place, the machinery for the manufacture of starch is a great deal simpler than that used in making sugar. The cassava manufacturing season may be extended throughout the year while with sugar cane this practice is possible only in limited regions. The present price of starch is higher than that of raw sugar and the yield to the hectare with the best variety of cassava is also greater than that of sugar cane. With sugar cane the yield to the hectare from fertile lands in Luzon is around five tons of sugar, while with cassava between six and seven tons of starch may be produced. The margin of profit from cassava is thus wider than that from sugar cane.

4. Because of the simplicity of the machinery required in cassava starch manufacture, which makes it possible to operate on a comparatively small capital, cassava may be grown profitably on a small as well as on a large scale and may be safely produced on a much narrower profit than sugar cane.

5. Local demand for cassava exists. This may be greatly extended as it is used both for food and in laundry work. As an export product it has possibilities for industrial purposes in glue manufacture, in sizing paper, and in cotton mills.

A by-product from the starch manufacture consisting of fibrous and protein material and unextracted starch may be used for animal feed of high calorific value—good for fattening hogs and other domestic animals. This by-product will add to the profit in starch manufacture.

Fancy food products, such as cassava pearl, table syrup, confectionery flour, may be produced for local consumption, thus helping to increase the use of the plant.

6. Cassava may be a cheaper source of starch than corn, as shown by figures furnished by the Department of Agronomy. The average production of shelled corn per hectare in the Philippines is 0.819 tons and in the Corn Belt of the United States, 2.514 tons. Assuming that there is 70 per cent starch in corn, these figures will give in the Philippines 0.573 tons of starch and in the United States, 1.800 tons.

The yield of starch from cassava is about six tons per hectare and it is manufactured in a much simpler way than corn starch is.

As our products enter the United States free, we may be able to invade American markets with starch that can undersell their corn product. The yearly production of starch producing plants (excluding wheat) in the

United States and Europe shows that the starch market of the United States and Europe is worth considering.

<i>Production of potatoes in U. S.</i>	<i>Value</i>
1921—361,659,000 bushels.	\$398,362,000
1922—453,396,000 bushels.	263,355,000
1923—412,392,000 bushels.	339,322,000
1924—454,784,000 bushels.	292,481,000

<i>Sweet potatoes</i>	<i>Value</i>
1921— 98,654,000 bushels.	\$86,894,000
1922—109,394,000 bushels.	84,295,000
1923— 97,177,000 bushels.	95,091,000
1924— 71,861,000 bushels.	92,290,000

<i>Corn production in U. S.:</i>	<i>Value</i>
1921—3,068,569,000 bushels.	\$1,297,213,000
1922—2,906,020,000 bushels.	1,910,775,000
1923—3,054,395,000 bushels.	2,217,229,000
1924—2,436,513,000 bushels.	2,405,468,000

<i>Corn production in Europe</i>
1921—298,802,000 bushels
1922—304,640,000 bushels
1923—385,357,000 bushels
1924—521,293,000 bushels

7. Cassava is not a permanent crop, so that in case of over-production a farmer can easily turn to other crops such as sugar cane and rice. Thousands of hectares of cassava land will be needed to supply the local demand for starch, and since we import practically all we are using, the production for the home consumption offers sufficient incentive for its cultivation in the Islands.

Considering these advantages is there any excuse for our importing *gaw-gaw*?

Some time ago a Filipino senator made the statement in the press that Filipino capital is both "timid and lazy". The first term may also be applied to our agriculturists. We leave the use of the second term to more daring critics. Evidently, there is lack of foresight and initiative among our farmers. Yet we have to have faith in the inherent progressiveness of our farmers and we should find a way to make them see the advantages to be found in some new fields. Their conservatism can be explained by the present make up of our urban societies and an apparent lack of business ethics among some of "the more enlightened," so that under their tactics the younger generation as well as the older usually have become "hard-boiled". Industrial development of this kind devolves on those who have the vision and absolute faith in our power to go ahead with a determination that will not allow failure.

The importation of cassava starch is not the only instance of the importation of products into the Philippines which can be produced here, but in

the case of cassava the advantages of its local production are more apparent than in some other products. With this product, lack of capital can not be invoked, as little is needed.

THE PLANTING AND CULTIVATION OF CASSAVA

It is not yet definitely known what varieties of cassava are best suited for commercial planting for the manufacture of starch. Some investigators recommend Aipin Valenca, Aipin Mangi, *Mandioca Basiorao* and *Mandioca sao Pedro Preto* as the best varieties for the purpose. These are high yielding varieties, superior to the native variety *Balinghoy*. Sison (1921) found that Aipin Valenca, *Mandioca Basiorao*, and *Mandioca sao Pedro Preto* are the best for commercial manufacture of starch, while Soliven (1921) in his investigation came to the conclusion that the Mangi variety gave the highest percentage (99.6 per cent) of starch during maturity with *Mandioca cassava* second with 91.09 per cent and Aipin Valenca third with 84.3 per cent. Foreign varieties growing in the College and planted on the hilly and dry portion of Rizal Province have given poor results.

Any part of the stem of the cassava plant, including the stumps, may be used for propagation, but the best part is the matured portion of the stem, with the exception of the part nearest to the root and the green portion at the upper end.

It has been claimed that the planting of cassava can be done any time of the year provided there is plenty of moisture in the soil. Opinions, however, vary as to the best time for planting. Many believe that planting should be done just before and during the wet months when there is plenty of moisture in the soil, or during the months of May, August, and November for Los Baños. Others are of the opinion that the best planting season is during the months of February and March when there is little rain. At this time the cuttings are able to root, but the weeds are unable to grow when the rain comes in May, and as a result the cassava having had a good start beats the weeds, and less weeding is necessary in the later development of the crop than when planted during the rainy season.

Well-drained sandy loam or rich light soil is recommended as the best for cassava production. Heavier soil requires deeper preparation. Soil where green manure has just grown produces good cassava.

Little cultivation is necessary for maximum production of cassava roots. If planted in February or March two cultivations are enough, the first to cover the furrows, and to be done before the fifth month after planting, while the second is to loosen the soil in between the furrows. It is also believed that during the early life of the plant it should receive shallow and through cultivation, or weed control.

Cassava may be harvested for food six months after planting any time within the year, but for starch manufacture it would be better to defer harvesting until the plant is about twelve months old. The time of matur-

ity, however, depends on the variety. Soliven found in his investigation that the variety Aipin Mangi should be harvested for food when from seven to eleven months old and for starch when from ten and one-half to twelve months old. Aipin Valenca should be harvested for food before it is eleven and one-half months old and for starch any time from ten and one-half to thirteen and one-half months old, while Mandioca cassava should be harvested both for food and starch at the age of from nine to eleven and one-half months.

When the plant reaches maturity and is left unharvested there is a rapid decrease of starch content, as shown in table 2.

TABLE 2
Relation of age and starch content of cassava roots

VARIETY	AGE	PERCENTAGE OF STARCH	VARIETY	AGE	PERCENTAGE OF STARCH
	<i>month</i>	<i>air-dry basis</i>		<i>month</i>	<i>air-dry basis</i>
Aipin Mangi	10	77.15	Angular	10	75.36
	11	78.45		11	75.50
	12	87.90		12	81.00
	13	99.60		13	76.27
	14	73.10		14	59.22
Aipin Valenca	8	68.50	White Smooth Intermediate	10	76.20
	9	76.50		11	77.12
	10	84.31		12	79.04
	11	84.00		13	69.00
	12	84.10		14	66.00
Mandioca cassava	8	67.66	Red	7	70.65
	9	83.16		8	71.60
	10	91.09		9	82.50
	11	86.46		10	75.60
	12	79.00		11	70.48

The time of harvesting also affects the yield of cassava as shown in the result of the experiment by Sison (see table 3).

It is the general belief that the yield decreases gradually and the roots become fibrous if left unharvested when matured. If the plant is cut and the roots left in the field for ratoon they become watery at first but later become normal as soon as new leaves have grown. There are, however, some who believe that cutting the plant spoils the roots and they later disappear.

The best planting distance is not definitely known, but reliable authorities claim that one meter by 75 centimeters, or one meter by one meter are reasonable. On good soil a distance of 120 centimeters by 150 centimeters is claimed to be the best.

TABLE 3

Effect of time of harvesting on yield of cassava per hectare (10,000 plants to the hectare)

VARIETY	10 MONTHS	11 MONTHS	12 MONTHS
Kapo Colorado.....	7,140	9,960	10,840
White Smooth Intermediate.....	8,640	12,360	12,300
Angular.....	9,280	12,940	13,860
Rough Intermediate.....	10,640	13,280	14,320
Kapo White.....	11,260	11,740	15,220
Casjave Singkong Manis.....	12,980	15,120	16,140
Aipin Valenca.....	18,320	20,320	20,970
Aipin Mangi.....	19,200	22,620	35,700
Mandioca Basiorao.....	36,060	37,780	38,280
Mandioca sao Pedro Preto.....	27,880	37,180	38,500

Ratooning of cassava may be done for two times or more, but experienced growers believe that it is not an advisable practice owing to the considerable inconvenience it causes to cultivation.

Harvested tubers should be used immediately for they deteriorate very fast, especially if cleaned of adhering soil. In harvesting, it is advisable to remove from the soil only such amounts as can be used on the same or the following day. Stems and cuttings of the stems may be kept for several months without planting them in the soil provided they are kept in a moist shady place and the roots coming from the nodes are allowed to reach the soil. In Java, careful experiments have shown that a planting which was cut twice, first at the age of two and one-half months and second at the age of five and one-half months, gave better yield when harvested at the age of twenty months than that in which no cuttings were made.

THE MANUFACTURE OF STARCH AND FLOUR FROM CASSAVA

Roxas and Manio (1921) carried an experiment on the manufacture of starch and flour from cassava. The experiment was made possible with the use of a cassava grinding machine designed in the College of Agriculture under the direction of Professor Cuzner then of the Department of Rural Engineering. The following is from Roxas and Manio:

The machine consists essentially of a power-driven cylinder on which is mounted a cylindrical grater, the roots being fed on to the cylinder through a hopper on the top. The grater was made by driving the points of sharp nails through a sheet of galvanized iron. A stream of water plays on this cylinder so as to keep it washed free from grated material. After the material is grated, it falls on to an oscillating sieve which is set at a slight angle so that the fiber which is left after the starch is washed out, falls off the lower end. The starch and water fall through into a trough which has a very slight pitch so that the current is slow, allowing the starch to settle as the water is drawn off.

Calculations of the production cost per kilogram of cassava starch

The average production cost per kilogram air-dry starch as estimated by Manio (1919) from results of two tests with the machine is taken from his calculation as follows:

Capacity of the machine per hour with two laborers.....	55.2 kgm. of roots
Expenses of the machine, including oil, fuel, interest, and two laborers at 12.5 centavos an hour, etc.....	42.5 centavos
Cost per kgm. of roots.....	77.0 centavos
Estimated yield of roots per hectare.....	50.00 tons

Operating cost at ₱0.77 per kgm. for 50 tons.....	₱385.00
Production cost of cassava roots.....	100.66
Total cost per 50 tons roots.....	485.66
Yield of starch from 50 tons roots at 24 per cent extraction..	12.0 tons
Cost per kgm. starch produced.....	₱0.0405

To the above cost, a charge estimated at 5 centavos a kilogram of starch should be added for over-head charges; that is, for packing, shipping, depreciation on the implements used, interest on the money invested, advertisement, etc. This would bring the total cost to about 10 centavos per kilogram.

Calculating on a production cost of 10 centavos and a wholesale price of 20 centavos per kilogram or 10 centavos net gain per kilogram of starch, cassava, when raised for starch, would give the farmer a net return of ₱1,200 per hectare. The wholesale price may be cut down to 15 centavos per kilogram and still leave a net profit of ₱600 per hectare which is considered a very good return. When this price is compared with the price of corn starch which is sold in pound packages at 35 centavos a package and *gaw-gaw* at 40 centavos a kilogram, it still leaves a wide margin of profit for the cassava grower.

PREPARATION OF CASSAVA FLOUR

The preparation of cassava flour consists simply of grinding the peeled roots without water and drying the product in the sun or with the aid of artificial heat to a moisture content of about 15 per cent. In this method, cassava flour of about 74.06 per cent starch content will be obtained which can be sold to the manufacturers of glucose or denatured alcohol. The cost of production per kilogram of flour is less than that of starch as the weight obtained from a hectare will be much greater. Assuming the average yield of 50 tons of roots per hectare, the yield of air-dry flour would be 21.77 tons.

The cost of production of cassava flour from 50 tons of roots would be about the same as starch, as the cost for the wash water is not included in the calculations. The cost per kilogram of flour would then be

$$\frac{485.66}{21.77} = 2.22 \text{ centavos.}$$

The same cassava machine used by Roxas and Manio in 1921 was loaned in 1926 to Mr. Leon Katigbak, an *hacendero* of Lipa, Batangas, and from the result of the first trial made with the machine, Mr. Katigbak seems to be very optimistic about the possibilities of his new field of endeavor. A part of his report as published in Volume XVI, No. 2 of THE PHILIPPINE AGRICULTURIST is herewith reproduced:

Judging by conditions under which I made my first trial, it would be worth while to engage in growing this crop by selecting a good variety and securing a fixed market for the product. I am having under careful observation the efficiency of the cassava bagasse obtained from extracting the starch as feed for hogs.

Statement of results of starch extraction and expenses in running the College grater:

Total net weight of the tubers peeled and cleaned.....	3,800 kgm.
Total net weight of starch obtained.....	581 kgm.
Total net weight of milled bagasse for hog feed.....	794 kgm.

Expenses incurred:

For pulling up the tubers in the field.....	₱ 51.00
For peeling the tubers.....	38.00
For milling the cassava and collecting the starch and bagasse.....	18.40

Total expenses..... ₱107.40

Value of the product:

581 kgm. of cassava starch at ₱0.20 a kgm.....	₱116.20
794 kgm. of cassava bagasse at ₱0.07 a kgm.....	55.58
Total	₱171.78
Expenses.....	107.40
Profit.....	₱ 64.38

Expenses for fuel in running the motor were not accounted for as the cassava grater as well as the mill for grinding the cassava were run by belting them to the engine of the sugar mill while the milling of the sugar cane was going on. But had a separate motor been used for the cassava machine, the expense for fuel would have run to a little more than a half a centavo per kilogram of peeled and cleaned tubers.

Under proper cultivation, 15,000 kilograms of cleaned and peeled tubers can very well be obtained from a hectare, if a good variety is used. On this basis and using the figures above indicated the value of the crop would be ₱256.20 per hectare.

BRIEF SUGGESTIONS

1. The most important step in starting a cassava plantation is the selection of a high yielding variety, such as Mandioca Basiorao.
2. Plant this variety in well prepared ground; cut the stem every two and a half months and allow the roots to ratoon and plant the cuttings, propagating it rapidly and thus extending the plantation. After five or ten hectares have been planted, the manufacture of starch may be started.
3. At first only a simple machine consisting of a grater and settling tanks and a simple mechanical dryer will be necessary. Later, the plant may be extended to include labor saving devices and a larger machine.
4. A manufacturing plant having a capacity of 2 tons of roots a day can handle 500 tons of roots in 250 days. This quantity can be grown on a plantation of about 20 hectares. Such a plant may be constructed for ₱2500.

PHILIPPINE LITERATURE ON CASSAVA

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THE RELATION BETWEEN THE TENSILE STRENGTH OF AN ABACA FIBER AND THE LENGTH OF THE INDIVIDUAL CELLS COMPOSING IT¹

CONSTANTINO G. DERECHO

INTRODUCTION

Abacá is generally considered the best cordage material. Since its value as cordage fiber is mainly dependent upon its tensile strength, a study of this physical property is obviously of great importance.

Review of literature

Espino (1915) determined the tensile strength of the fiber from the edge and middle portion of every leaf sheath of an abacá stalk. He used a very simple apparatus consisting of two iron stands which support a horizontal iron bar. At the middle part of this bar is a clamp which holds the upper end of the fiber to be tested. The determination of the tensile strength was made by continually suspending more weights at the lower end until the fiber broke. He found, among other things, that "contrary, . . . to the common belief, fiber composed of long cells is weaker than that composed of shorter ones."

Espino and Esguerra (1923), Espino and Reyes (1923), Ocampo (1924), Yango (1924), Rivero (1924), Tolentino (1924), Hautea (1924), Ventura (1925), Lopez (1925), Dres (1925), and Gonzalez (1926) determined the tensile strength of the fiber from the edge and middle parts of every leaf sheath in the stalk of fifty-four varieties of abacá. They used practically the same method employed by Espino. Gonzalez summarized the results of all the previous investigators on the subject. He concluded that there is no correlation between the tensile strength of abacá fiber and the length of the cells composing the fiber strand.

The conclusions arrived at by Espino and Gonzalez are contrary to the general idea, as stated by Copeland (1921) and Matthews (1924), that other things being equal, the longer the individual cells composing a fiber, the stronger it should be.

Object of the present study

It was the object of the present study to determine the relation between the tensile strength of an abacá fiber and the length of the individual cells

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composing it, by using a more suitable material and a more accurate apparatus than were used by the investigators named.

Time and place of the present work

This work was conducted in the College of Agriculture, Los Baños, from April 1926 to January 1927.

MATERIALS, METHODS, AND RESULTS

The fiber was obtained from a fruiting stalk of Maguindanao variety. Extraction was made by the use of a native stripping machine. The fibers used in this experiment were obtained from the middle portion of the leaf sheaths. The tensile strength was determined by means of a hand-operated single strand tester, manufactured by Henry L. Scott and Company, Providence, Rhode Island. Good long fiber strands from the sixth, seventh, ninth, and fourteenth leaf sheaths were tested. Every fiber strand was divided into three parts: lower, middle, and upper, each part being separately tested. The number of fiber strands tested for each leaf sheath was from 60 to 75.

The length of the fiber cells from the fiber of the same leaf sheath was also measured with a Bausch and Lomb binocular microscope, using 40 millimeter objectives and 10× eyepieces. Each fiber was divided into three parts—the lower, middle, and upper. The length of 100 cells in each part was measured, so that 300 determinations were made of each fiber.

Separation of the fiber cells was accomplished by macerating the fiber in diluted nitric acid to which a little potassium chlorate had been added. Care was taken not to overcook the fiber.

TABLE 1

Showing the average length of the fiber cells from different portions of the fiber strand in each leaf sheath

POSITION OF LEAF SHEATH	SOURCE OF SAMPLE		
	Lower	Middle	Upper
	mm.	mm.	mm.
Sixth.....	3.59 ± 0.020	4.64 ± 0.025	4.11 ± 0.019
Seventh.....	3.21 ± 0.004	3.85 ± 0.033	3.68 ± 0.024
Ninth.....	3.18 ± 0.022	4.25 ± 0.019	3.82 ± 0.023
Fourteenth.....	4.53 ± 0.018	4.61 ± 0.023	3.92 ± 0.018

TABLE 2

*Showing average tensile strength of abacá fiber in different portions of leaf sheaths
(All data in kilogram per gram meter)*

POSITION OF LEAF SHEATH	SOURCE OF SAMPLE		
	Lower	Middle	Upper
Sixth.....	39.46 ± 0.543	57.90 ± 0.635	44.32 ± 0.511
Seventh.....	42.11 ± 0.971	56.06 ± 0.688	35.93 ± 0.708
Ninth.....	37.31 ± 0.596	49.60 ± 0.481	35.47 ± 0.478
Fourteenth.....	31.95 ± 0.344	32.37 ± 0.380	31.72 ± 0.446

In table 1 are shown the averages of the lengths of the fiber cells from different portions of the fiber strands in each leaf sheath. Table 2 shows the results of the tensile strength determinations. To make the results of the tests comparable, the weights were reduced to kilograms of breaking weight per gram meter. This was computed in the following manner: After every test, each sample which was 25 cm. long was weighed and the weight was multiplied by 4. The breaking weight was then divided by the product and the result is the breaking weight per gram meter.

DISCUSSION OF RESULTS

It has been stated that according to Espino, long-celled fiber is weaker than short-celled. Espino, however, compared fiber strands which were composed of long but thin-walled cells with fiber strands composed of short but thick-walled cells.

Ocampo and Hautea concluded from their study of the tensile strength of fiber from different varieties of abacá that the tensile strength of an abacá fiber strand is not correlated with the length of the cells. Gonzalez after reviewing his own work and that of Espino and Esguerra, Espino and Reyes, Ocampo, Yango, Rivero, Tolentino, Hautea, Ventura, Lopez and Dres, on the length of the individual cells and the tensile strength of the fiber from different varieties of abacá arrived at the same conclusion.

It is evident from these investigations that the materials used were not strictly comparable. The fibers vary in age according to the position in the stalk of the leaf sheath from which they come, and it is well known that the tensile strength of abacá fiber varies with age. Besides, the fibers were from different varieties, a fact which evidently was not taken into consideration.

In the present investigation, the determination of the relation between the tensile strength and the length of the cells composing the strand was made, as previously stated, by dividing the strand into three parts—the lower, middle, and upper. Then the length of the cells and the tensile strength of each portion was determined.

The determinations of the length of 100 individual cells from the lower, from the middle, and from the upper portions showed that the cells from the middle portion are considerably longer than those of the lower and upper portions. The average length of the middle portion may be from 22.63 to 33.81 per cent above the lower portion and 10.11 to 24.12 per cent above the upper portion (table 1).

Determination of the tensile strength shows that the middle portion is considerably stronger than the lower and upper portions (table 2). The average tensile strength of the middle portion of the sixth, seventh, and ninth leaf sheaths is from 24.82 per cent to 31.85 per cent higher than the lower portion and 23.45 per cent to 35.88 per cent higher than the upper portion. In the fourteenth leaf sheath the difference is not significant.

This may be explained by the fact that the fourteenth leaf sheath is still very young; hence the young cells of the fiber are not yet firmly cemented together.

Since the comparison of the tensile strength and the length of the individual cells was made from the same strand, the varietal influence was entirely eliminated.

There remains the influence of age to be considered. From the nature of the growth of abacá, it is obvious that the upper end of a fiber is the oldest part and the lower end, the youngest. To get around the difficulty with respect to age, the fiber was divided, as has been stated, into three portions. The middle portion is younger than the upper and older than the lower portion of a fiber strand. Since the middle portion in all cases has longer cells and higher tensile strength than the lower and upper portions it may be concluded that the difference in the tensile strength in favor of the middle portion is due to the fact that the cells composing it are longer. The general idea that the longer the cells composing a fiber, the stronger it should be, other things being equal, is therefore confirmed.

The above findings may be considered as having considerable economic significance. As has been stated, the value of a fiber for cordage is mainly dependent on its tensile strength. By separating the middle portion, a quantity of abacá fiber having high tensile strength may be obtained. This may be employed for cordage that requires great strength.

SUMMARY AND CONCLUSIONS

1. Some investigators seem to have found that there is no direct correlation between the tensile strength and length of the cells of abacá. This is contrary to the general idea that, other things being equal, the tensile strength of a fiber is directly proportional to the length of the individual cells composing the strand. A close study of the work of these investigators, however, appears to show that they have used materials which are not strictly comparable.

2. In this investigation, the tensile strength of the different portions of single fiber strands of abacá has been studied in connection with the length of the cells composing similar portions.

3. It was found that there exists a direct correlation between the tensile strength and the length of the cells composing a fiber.

4. The fact that the middle portion of an abacá fiber is stronger than the other portions is of considerable practical significance.

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QUADRATURE PARTS OF CONICS

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INTRODUCTION

In a discussion among teachers, the question was once asked if there was a geometric meaning to imaginary values of a variable in an equation: for example, where may we place the point $(o, \pm 3i)$ or the point $(\pm 1, \pm \frac{\sqrt{3}}{2}i)$ of the curve $\frac{x^2}{4} - \frac{y^2}{9} = 1$? We say that such points

do not exist. What is the real meaning of the phrase "do not exist"? Does it mean that they do not exist at all, or that they do not exist in the plane in which the equation $\frac{x^2}{4} - \frac{y^2}{9} = 1$ traces a hyperbola?

I tried to answer these questions by the following discussion:

DISCUSSION

Definition. When the (x, y) plane is given and considered to contain ordinary (real) points, the y -quadrature plane will be for points with x ordinary and y in quadrature (imaginary), or the (x, iy) plane, through the x -axis and perpendicular to the y -axis. Similarly, the (ix, y) plane passes through the y -axis and is perpendicular to the x -axis.

Euclidian geometry can not admit of an (ix, iy) plane, a plane that would be perpendicular to the x and y -axes at the same time.

$$\text{I. } \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1, \text{ is identical with either}$$

$$(a) \frac{x^2}{a^2} - \frac{(iy)^2}{b^2} = 1, \quad x > |a|, \text{ a hyperbola}$$

in the (x, iy) plane;

$$(b) -\frac{(ix)^2}{a^2} + \frac{y^2}{b^2} = 1, \quad y > |b|, \text{ a hyperbola in}$$

the (ix, y) plane.

$$\text{II. } \frac{x^2}{a^2} - \frac{y^2}{b^2} = 1, \text{ is identical with } \frac{x^2}{a^2} + \frac{(iy)^2}{b^2} = 1, \quad x > |a|,$$

an ellipse in the (x, iy) plane. It is also identical with

$$\frac{(ix)^2}{a^2} + \frac{(iy)^2}{b^2} = 1 \quad \text{which gives}$$

$$y = \pm \frac{b}{a} i \sqrt{(ix)^2 + a^2},$$

a quadrature y for every quadrature value of x , which can not be considered in Euclidian geometry.

- III. $y = 4px$ is identical with $(iy)^2 = -4px$, $x < 0$ a parabola of the same dimensions, but "oppositely" facing, in the (x, iy) .

But $-y^2 = 4p(ix)i$, shows that the first parabola has no "quadrature part" in the plane (ix, y) .

- IV. The "quadrature parts" of a circle are two equilateral hyperbolas, $x^2 - (iy)^2 = r^2$ and $-(ix)^2 + y^2 = r^2$.

NOTE:—The word "quadrature" was taken from Steinmetz *Engineering Mathematics*: it is a term which I believe is better than "imaginary".

NOTE: A NEW AGRICULTURAL JOURNAL IN INDIA

This new periodical which made its first appearance early this year is the *Journal* issued by the Central Bureau for Animal Husbandry and Dairying in India. As the foreword by Lord Irwin seems to carry some suggestions that may be worth pondering by landholders and other molders of opinion in the Philippines we reprint it from the *Leader* June 2, 1927 (Allahabad, India).

Since the Great War agriculture in England has passed through a period of acute depression. Fluctuating prices and unstable markets have hit farmers badly, and they have been forced to realize that agriculture cannot pay unless it is worked on scientific lines. They are now anxious to take advantage of all that scientific research and experiment can give them, and they are also paying greater attention to the fundamental principles of cattle breeding, cattle-feeding, cattle diseases and dairying, and to the general economics of animal husbandry.

Here in India the same problems confront us as in England, and we must move with the time.

Thanks to the efforts of the Imperial and Provincial departments of Agriculture much is already being done. Cattle-breeding farms have been established, pure-bred herds evolved by selection, and improved bulls supplied for stud purposes to cattle-owners. Successful experiments have been made to increase the milking capacity of cows and continuous efforts are being made to produce sound dual purpose breeds. Courses of instruction in dairying have been instituted, and investigations into the principles underlying stockfeeding have been carried out.

In these ways Government is doing a good deal to improve animal husbandry and dairying, but this is not enough. It is on the big landholders that the country must depend if real progress is to be made.

For the past two centuries England's gentlemen farmers have taken the lead in stock-breeding. They felt that this leadership was a duty they owed both to the farming community and to the State and as a result of their efforts stock breeding has been the mainstay of British agriculture, and England has become the Stud Farm of the World.

Let India's landed aristocracy follow their example.

Scientific cattle-breeding does not ordinarily pay today because it costs more to breed and rear good animals than they are worth when reared, and ready for disposal. But this is because cattle owners are not as yet sufficiently enlightened to pay for pedigree. It is the function of those who can afford it to realize their social obligations and develop cattle im-

provement on scientific lines, even if it does not bring them immediate financial reward. The time will undoubtedly come when sufficient farmers will realize its value and be prepared to pay for it.

At present the tendency of the educated classes is to immerse themselves in politics or the law. These two spheres of action are important and necessary for the constitutional administration of the country, but they are not the vital necessities on which the people of India depend for their very existence from day to day. What is the good of concentrating on strong reins to drive a horse or on rubber-tired wheels to make the carriage comfortable if the horse is so weak that he cannot pull the carriage, or the carriage so frail that it falls to pieces directly anybody sits in it?

Education therefore should be directed into practical channels, and it should be the first aim of all of us to do everything that we can to foster and improve that basic industry of agriculture on which India more perhaps than any other country is dependent.

One of the principal objects of this journal will be to stimulate the interest of Indian landowners in animal husbandry, and to gain their support in building up Indian pedigree herds. I commend this object to everyone who is interested in the material and moral welfare of the people of India, and as head of the administration of this great country, and as one who has always taken a keen and personal interest in all that pertains to agriculture, I wish the journal all success.

Dr. W. A. Orton, of the Tropical Plant Research Foundation, says: The greatest contributions of the tropics in the future will be of sugar, oils and fruits. The principal industry of the tropics will probably continue to be agriculture, but for its fullest development much scientific work will have to be done which is now in its very earliest beginnings. As an example, such important crops as rubber, coffee, and cacao, and most of the tropical fruits, are still propagated from seeds, whereas virtually all the important tree crops of the temperate countries have been for years, sometimes for centuries, carried on as choice grafted stocks and not left to the uncertain chances of seedling growth. Another problem is the apparently paradoxical lack of fresh vegetables on the tropical menu. Whatever may be the cause of this deficiency, medical workers find that part of the lassitude and inefficiency of native laborers is apparently due to lack of necessary vegetable vitamins.

—*Science*—supplement.

Don't wait for great opportunities. Seize common, everyday ones and make them great.

—*The Kalends* (Williams and Wilkins Co.)

EXTENSION DIVISION NOTES

Well-Being and Happiness for the Average Filipino

The following is a set of short rules written by the late Dean Baker as a simple guide for the average Filipino farmer in attaining success in economic independence and in the free exercise of his right of vote to exalt to public office men of his own choosing.

"The whole economic structure of the Philippines rests in the last analysis upon the average farmer. The average farmer is a small landholder or a tenant and his economic condition is granted by all with intimate knowledge of the matter to be usually precarious and financially unsound. What are the most important principles which he must observe in order to attain a reasonable degree of economic independence, of self-sufficiency, of success. We suggest:

1. Avoidance of debt at any sacrifice—rigorous living within income;
2. Cutting out of gambling in all forms;
3. Building up of a small emergency cash reserve;
4. When tenantry yields no betterment and becomes intolerable, then remove at once to a free homestead.
5. Obtaining of maximum returns for unit of land and labor by use of fertilization, seed selection, and better cultivation;
6. Inviolability of voting power and absolute freedom in use of the vote to elect to public office only men of probity who are known to be loyal to the interests of the common man."

C. F. BAKER
Dean

Build up a Farm of your Own

In response to Dean Baker's request, the following set of rules was prepared as a supplement to the preceding set.

Everybody takes pride in owning his own house together with the houseyard.

In the same way a farmer takes pride in the farm which he can call his own.

Keeping the house and houseyard properly improved will bring an incalculable profit in the form of comfort and happiness to the family.

In a similar way, keeping the farm improved by proper management, helps to make it yield enough to meet the family's needs and in addition a surplus for a saving.

To realize this ideal, the following suggestions may be made:

1. Own your farm and build your home on it, so that you may attend to your farm work more closely and more economically.
2. If you are working as a tenant, make your tenancy a sure step to farm ownership.
3. If you are working as a farm hand, make it as a sure step to tenancy, or, if possible, to straight farm ownership.
4. At this time—not later—it is much easier in the Philippines than anywhere else to own a farm of 24 hectares (almost free) by applying for a homestead.
5. Save as much as you can out of your farm profits and other earnings in order that you may either buy a farm, or preferably occupy a homestead, and develop it.
6. For any business you may be engaged in, always keep a careful account of your operations, yearly expenses and income.
7. Your business may be called a success when your income is greater than your expenses, for a year or for a number of years—depending upon the nature of your farm enterprise.
8. Make a careful study of the market for your produce as it changes from time to time.
9. Raise on your farm what will bring you the largest amount of profit, and use this as a guide for your system of farm operations.
10. Be ever ready to initiate or join and take a very active part in a community movement tending to make your methods of production and marketing more profitable for your own welfare and that of your community.

INOCENCIO ELATDA
Director, Extension Service

The Rice Question

The Philippine rice farmer is now facing a situation not known before in this country. That is, a price of rice is lower than has ever been known. At the present price it will no longer pay to produce rice under the existing conditions on our farms. The people are greatly alarmed. Every day the newspapers are filled with items concerning the rice question. Solutions are being sought for the present problem. Many are thinking of a possibility of exporting rice. A petition has been sent to the Acting Governor General asking him to lift the ban on exporting rice which has been in effect since 1919. Mr. Fidel Reyes, Director of the Bureau of Commerce and Industry, has written a very strong letter to the Acting Governor General urging the lifting of the ban.

Opinions, however, differ as regards the possibility of exporting rice. It is believed by some prominent rice dealers that it is quite impossible to export Philippine rice to foreign countries, as China and Japan. It is said that it would be necessary to reduce the price of rice to at least ₱6 a cavan

if it is to be exported to China. Rangoon and Saigon rice sells in the neighboring markets at ₱8 a cavan and considering the cost of transportation and the high tariff duties in Chinese ports it would be quite impossible for Philippine rice to compete at that price. A wealthy rice dealer said that "it needs a very serious study of the situation before we ever attempt to export rice."

In considering the question of exporting rice or in other words of increasing the price of rice, another phase of the question should be considered. While it is true exportation may benefit the rice growers, what about the producers of the coconut, the abacá, the tobacco. They are all rice consumers and if the price of rice goes higher these people will be greatly affected. So that the price of rice must not be increased to an extent that will be detrimental to these crop producers. This was well explained by Senator Juan Alegre in his argument against the lifting of the ban. He stated that at one time rice in the Bicol region sold as high as ₱25 a cavan.

The Bureau of Health prepared a memorandum opposing the lifting of the ban. The memorandum states that the lifting of the ban would tend to decrease the amount of unpolished native rice and increase the importation of polished rice from Saigon. The Bureau claims that the Saigon rice is devoid of vitamins and, when used in the diet to a certain degree, causes beriberi. The memorandum further states that beriberi is third among the diseases in point of prevalence and mortality and that the lifting of the ban in no very long period may make the disease the most dangerous in the Philippines.

Another remedy offered to improve the rice situation, is to decrease production. One of the victims of the low price of rice is a graduate of the College of Agriculture. He is so dissatisfied with the present situation that he is considering growing other crops. He says that there are quite a number of rice farmers in his locality who are contemplating planting sugar cane instead of rice. He, himself, is looking for a place where he can invest in fisheries. He is planning to go to Mindoro where he expects to find the place he wants. He says that if those who are contemplating changing their crop to sugar cane push their plan through it would mean a reduction of rice production and may result in better prices.

The present situation seems very interesting from an economic point of view. The price of rice is very low. People are thinking of exporting rice. But, has the Philippines produced enough rice to feed the whole Filipino people? It has not. We are still importing millions of pesos worth of rice. Millions of sacks of Saigon rice are still coming to Philippine soil. We have no right to talk of over-production. It has not yet come. The present problem is a problem in agricultural economics. It is a simple economic phenomenon governed by an economic law. There is a break in the economic balance which has resulted in this economic disturbance. Too much of one kind of a commodity has been produced in one region, but

though it could be consumed by the people of the archipelago, it has been impossible to distribute it evenly. Thus the inability of even distribution of the commodity has resulted in the over-stocking in some regions and consequently an abnormally low price. This is the cause of the rice situation.

Other questions may be asked in this connection. Why can foreign rice compete with our rice in our own country in spite of the tariff levied on imported rice? Can it be that there is something wrong with our tariff on rice? Could the consideration of our rice tariff have any bearing on our rice problem? Such questions are worth considering.

EXCHANGE NOTES

More than 800 varieties of rice are growing today at the United States experiment station near Biggs and from this lot Jenkins W. Jones, superintendent, expects to hybridize a rice that will be a heavy yielder and early producer.

The crops of the different varieties are the products of seed brought by Jones from Japan, Korea, China, and India.

Jones is seeking a rice that will head out about August 10 and ripen about September 15, yielding heavily. All of the foreign rice seed is growing under normal Sacramento Valley conditions.

—*Cultivator* (California).

"Until a child is thirteen," reports the American Child Health Association, "a quart of milk a day is vital to complete development."

"According to Canada Public Accounts," writes Arthur Gibson, Dominion Entomologist, in *Scientific Agriculture*, "there was spent on war and demobilization, during the years 1915 to 1926, the sum of \$1,694,557,202. During the same period, the losses in Canada from destructive insects amounted to at least \$1,375,000,000."

—*The Journal of Agriculture and Horticulture* (Canada).

Figures collected by an appraisal company indicate that a farm building put up in the ordinary way with siding, and left unpainted will last about 20 years, whereas the same building painted every five years will last about 50 years. In the case of the unpainted building if the siding is replaced at the end of 20 years the cost would be about the same as it would have been to paint it every five years. This is not the whole story, however, as the unpainted building at the end of 20 years will have only about 15 per cent of its original value, whereas the painted building at the end of 50

years will have about 20 per cent of its original value. This makes no allowance for the great advantage of good appearance.

—*Prairie Farmer* (Illinois).

The market is deemed but one factor rather than the fundamental cause of poor returns to agriculture. Net income depends upon the quantity of products for sale and the cost of production, as well as the price received. Climate, soil, and equipment affect quantity and quality of the product and cost of production, but the most important factor influencing profits from agriculture is the farmer himself.

—*Experiment Station Record* (U. S. Dept. Agric.).

During recent years in California, where citrus production has been widely studied as a business, the consensus of opinion of many investigators is expressed in a bulletin by R. W. Hodgson. He states that in California experience nitrogen is the only element, and organic matter the only other material which have been demonstrated to give measurable improvements in yield and tree health. He adds that applications of phosphorus and potassium have been made for six years, and no measurable improvement has been noted in certain experiments.

About 200 lb. of nitrogen per acre is the amount recommended for young bearing trees, half of which amount is preferably applied in an organic bulky form, and the remainder in an inorganic or chemical form. For older trees—12 to 20 years old or more—the applications may be increased to 300 lb. of nitrogen per acre.

Such applications of nitrogen will appear tremendously heavy to many growers, especially when it is realised that the following amounts of fertilisers are required to provide 100 lb. only of nitrogen per acre, viz., dried blood, 833 lb.; blood and bone, 2,000 lb.; nitrate of soda, 666 lb.; sulphate of ammonia, 500 lb. Hodgson remarks that it does not appear to matter which of these nitrogenous manures are used. They all appear to give similar results, providing that they are applied in time for the tree's requirements.

—*Agricultural Gazette* (New South Wales).

Fish Chowder can be made with a two-pound piece of any kind of white fish cut into one-inch squares. Measure an equal quantity of potatoes cut into half-inch squares. Fry a scant quarter-pound of salt pork, diced, with a medium-sized onion, thinly sliced, until both are tender, but not brown. Place the above ingredients in alternate layers in a soup kettle, add boiling water to cover generously. Salt and pepper to taste and cook gently for

one-half hour after it begins to boil. Scald one pint of milk and thicken it with two tablespoonfuls of flour blended in a little cold milk. When thick and smooth add to the fish mixture, cover the top with split-and-buttered round crackers and serve. The potatoes will be more tender if parboiled for ten minutes before combining with the fish. To vary this, a pint of tomatoes may take the place of a pint of water, improving the dish for many tastes.

—*Agricultural Society (Jamaica).*

COLLEGE AND ALUMNI NOTES

Mr. José F. Zamora B. Agr. '11, recently elected member of Board of Regents as U. P. Alumni representative, addressed the Student Body Convocation on September 22. Regent Zamora is the first College of Agriculture alumnus—not on College faculty—to address our Student Body.

Mr. Zamora gave many interesting sidelights on the pioneer days in the College. Apparently his College days in spite of tent class rooms and heavy manual labor are treasured happy memories. After the reminiscences, he gave counsel of value on farming as seen by a farmer. Mr. Zamora has made such an outstanding success in farming that he was granted the honorary degree of Master Farmer by the U. P. Hence, he spoke of realities, not theories.

Mr. Gregorio Francisco, B. S. Agr. '17, another of our Master Farmers, was a College visitor for a few days recently. Mr. Francisco is a very successful rice farmer in Nueva Ecija.

Mr. Marcelo V. Arnaldo, B. S. A., '27, writes Professor Lopez that he is now employed as Rural Credit Agent of the Bureau of Agriculture with station in Panay. His district comprises the provinces of Iloilo, Antique, Capiz, and Occidental Negros. Mr. Arnaldo majored in rural economics under the advisership of Professor Lopez. His thesis deals with marketing agricultural products in Laguna.

Doctor Research to the Rescue, prepared under the direction of the Department of English, was recently issued in mimeograph as Circular No. 13. This circular, according to title page, "illustrates and presents agricultural problems in dramatic form". The foreword states that "This circular, *Doctor Research to the Rescue*, is issued with the hope that it may be of help in showing farmers where to go for counsel and in showing farmers and others that research work in laboratories in agricultural colleges is not a waste of time and money, but produces results of much practical value".

Six of the nine scenes given in the Circular were presented last January in the College. The dedication of *Doctor Research* by Dean Baker is "To the Students of the Philippines".

Miss Kathleen McGregor Davis, graduate from The Horticultural College, Swanley, Kent, England, who spent a few days at our College last March, writes from London to Professor Yule. We feel parts of the letter are of such wide interest that we quote:

When I arrived in England the country was looking its best and I seemed to look upon it with quite a different pair of eyes and then I began thinking over my trip and I came to the conclusion that of all the wonderful and beautiful places I had visited the Agricultural College at Los Baños was the place most of all that I should like to visit again. I am not saying this just to please but because I really mean it. Those were red letter days for me and if you ever wonder if you have made some one really happy, you need have no doubts whatsoever. I went down to Swanley for Old Students' Week-end and made everyone including members of the Staff so envious by the description of my visit to your College.

I had a long talk with the Principal, Dr. Kate Barratt, and she gave me the enclosed papers to send to you in case they might interest you and I am also sending you an old number of the College Magazine as it contains a letter from an old student who is teaching Horticulture in the United States. I was a Hostess at a Garden Lovers Dinner at the end of June and I did wish so much you could have been there. Among our guests were Dr. Barratt of Swanley and a Mr. Cowley, editor of one of our Gardening papers. The Curator of the Apothecaries Garden, Chelsea, was also there and gave me permits to visit the Garden, which I did. This Garden was started by the Company of Apothecaries in 1673 for the use of those interested in Botany and as a place in which to grow their specimens, and ever since those days it has been a source of great interest to Botanists and it is a great help now-a-days to students who are granted permits for studying there. Philip Miller, who was appointed Head Gardener in 1722, should, I think, be canonized by the American people! In 1732 he sent a packet of cotton seed to that colony in America founded for poor debtors and called after George II—Georgial and from this seed comes three quarters of the World's cotton. And when I read this I thought of Dean Baker and felt that one day in the Philippines he would be also remembered in some similar way. Linnaeus and Kalm visited the Garden and John Evelyn mentions it in his Diary. Every plant seems to have some interesting association and I spent a wonderful afternoon with the Curator returning home laden with knowledge and specimens. I thought how amused Mr. Julianio would have been to see *Ardisias* being carefully nourished under glass (we collected them the day we climbed Maquiling) and the Dean had he seen the Water Hyacinths also being carefully cared for!

I was reading an old book on Gardening the other day and found the following which may amuse you—

"Thomas Johnson exhibited in his window the first bunch of bananas seen in London, 1633. They hung from April 10th until the end of June when they were soft and tender and ready to be eaten."

The Mimics made their first appearance this year on the evening of October 1. Under the able direction of Rev. Hugh Bousman, Student Pastor of the Student Union Church, the club presented two one act plays.

The *Cottage on the Moor* by E. E. Smith and D. L. Ireland presents a bit of England in the days of the Roundheads and the Royalists.

Cast of Characters

Old Man	- - - - -	Nicolas Llanes
His Grandson	- - - - -	Loreto Valera
Royalist Officer	- - - - -	Felix Villa
Sergeant of the Roundheads	- - - - -	Antonio Madarang
Trooper of the Roundheads	- - - - -	Miguel de Guzman

The second play, *Clauses 3 and 4* by Jorge Bocobo, is a lively bit of Filipino life in the present.

Cast of Characters

Mr. Gatdula, Attorney, graduate of an American University	-	Constancio Medrana
Mameng, U. P. Graduate, B.A.	- - - - -	Manuela Maramba
Ninay, U. P. Graduate, H.S.T.C.	- - - - -	Laura Martelino
Juan Valle, Freshman, College of Agriculture	- - - - -	Domingo Tugade
Mr. Merlain, a young dramatist—Nasario Pidlaon....	} U. P. Graduates—Mameng's suitors	
Dr. Desa, a young doctor—Paulino Ungos.....		
Mr. Quiñon, a young attorney—Alfonso Briones.....		
Ricardo Santillana, a government employee	- - - - -	Fortunato Basilio
Reyes, Clerk in the Gatdula Law Office	- - - - -	Francisco Franada
Guests	- - - - -	Misses Mercedes Martelino and Maxima Mulimbayan
Servant	- - - - -	.....

The Tri-College Chorus under the direction of Mrs. Bousman added much to the evening with three College songs: "Hail to our Philippines," "Rah! Rah! Song" and "Wahoo Song," and with two other numbers, "The Rosary" and "The Bells of St. Mary's."

The higher up in life that a man goes the more necessary it becomes that he shall coöperate with other men. Any man's success depends largely upon the efforts of others, and anyone who is not willing to share his success with these others very seldom has much success to share.

HOW TO GET THE BEST OUT OF YOUR JOB

Reprinted from the *Agricultural Journal* (Queensland) with the suggestion that it is good stuff for "Creed for 1928".

Respect it.
Take pleasure in it.
Don't feel above it.
Put your heart in it.
See the poetry in it.
Work with a purpose.
Do it with your might.
Go to the bottom of it.
Do one thing at a time.
Be larger than your task.
Prepare for it thoroughly.
Do it cheerfully, even if it is not congenial.
Do it in the spirit of an artist, not an artisan.
Make it a stepping stone to something higher.
Endeavour to do it better than it has ever been done before.
Do not try to do it with a part of yourself, the weaker part; be all there.
Keep yourself in condition to do it as well as it can be done.
Believe in its worth and dignity, no matter how humble it may be. Accept the disagreeable part of it as cheerfully as the agreeable.
Choose the vocation for which Nature has fitted you.
See how much you can put into it instead of how much you can take out of it.
Remember that it is only through your work that you can grow to your full height.
Train the eye, the ear, the hands, the mind—all the faculties—in the faithful doing of it.
Remember that work well done is the highest testimonial of character you can receive.
Use it as a tool to develop the strong points of your character and eliminate the weak ones.
Remember that every vocation has some advantages and disadvantages not found in any other.
Regard it as a sacred task given you to make you a better citizen, and to help the world along.

Remember that every neglected or poorly done piece of work stamps itself ineffaceably on your character.

Write it indelibly in your heart that it is better to be a successful cobbler than a botched physician or a briefless barrister.

Refuse to be discouraged if the standard you have reached does not satisfy you, that is a proof that you are an artist and not an artisan.

Educate yourself in other directions than the line of your work, so that you will be a broader, more liberal, more intelligent worker.

Regard it not merely as a means of making living, but first of all as a means of making a life—a larger, nobler specimen of manhood.

—O. S. M. in *The Dawn*.

“EVERY LITTLE BIT ADDED TO WHAT YOU’VE GOT MAKES A LITTLE BIT MORE”

Thrift in material matters means saving intelligently, spending prudently and investing wisely. We have learned many lessons well. We believe that education is a valuable investment. There are, however, lessons that we have not learned. We have not learned the habit of setting aside a definite sum each month for permanent investment. We need to learn this lesson.

The small amount of ten cents a day saved daily from the age of twenty-one to the age of sixty-four and invested permanently at the current rate of interest will amount to over four thousand dollars. Twenty cents a day for the same period at the current rate of interest will meet the demands of the statistician for the requirements of old age.

A banker recently said, “The power a man puts into saving measures to the power of the man in everything he undertakes.”

CHARLES FULLER BAKER.

Through wisdom is a house builded;
And by understanding it is established;
And by knowledge are the chambers filled
With all precious and pleasant riches.

—Prov. 24:3, 4.

CHEMICAL STUDIES ON COCONUT PRODUCTS: I. THE CRITICAL MOLDING-MOISTURE CONTENT OF COPRA, AND SOME METHODS OF PRESERVING IT.¹

V. G. LAVA

Of the Department of Agricultural Chemistry

WITH ONE CHART

OBJECT OF THE PRESENT WORK AND REVIEW OF THE LITERATURE

The objects of these notes are to study the relation between the aqueous vapor tension of the atmosphere surrounding copra and its water absorption capacity and the effect of water upon the deterioration of copra by molds in presence of atmospheric oxygen, and to test some laboratory methods of copra preservation.

Among the important observations of different investigators, the following may be cited: Brill, Parker, and Yates (1927) found (1) That copra stored in open air will lose or gain water until this is in equilibrium with atmospheric moisture, the equilibrium point being reached when a moisture content of about 5 per cent is reached;

(2) That the water content of copra is not uniformly distributed, the layer adjacent to the water portion of the coconut containing more moisture than the layer near the shell;

(3) That when dried to a moisture content of 6 per cent, copra does not mold when stored where there is circulation of air, but that when kept in a saturated atmosphere, it will, after one or two weeks' exposure, absorb enough water to enable mold to grow;

(4) That while well-dried copra neither becomes hot nor evolves CO₂, when piled in storage, copra containing from 10 to 20 per cent moisture evolves CO₂, and increases the temperature of its surroundings; these two effects being parallel, and showing that the heat is produced by the deterioration of the copra;

(5) That copra (of moisture content 10-20 per cent) stored in a *bodega* loses very much weight through the action of molds, the green mold being the least harmful, and the brown mold destroying as much as 35 per cent of the oil in the copra within 30 days.

Walker (1906) and various other workers who have obtained somewhat similar results found

¹ Experiment Station contribution No. 479. Received for publication, August 12, 1927.

(6) That most of the free acid and the accompanying "rancidity" (*i.e.* the bad taste and odor) is produced in the copra itself before the oil has been expressed;

(7) That the destruction of fat with the consequent formation of a relatively large amount of acid in copra is caused by molds acting either alone or in conjunction with certain bacteria, a water content of 9-10 per cent (at a temperature around 35°C.) being the condition most favorable to the growth of these organisms; and

(8) That the destruction of the non-fatty portion of the copra is caused by several species of bacteria, this decomposition being accompanied by formation of only a very little acid, and occurring most favorably when the copra has a moisture content of 23-50 per cent.

Another point on the chemistry of rancidity which seems to have been agreed upon by investigators, such as Kerr (1921) and Emery and Henley (1922), and Powick (1923) is

(9) That rancidity results through the oxidation of fats by atmospheric oxygen in the presence of light or of certain metals as catalyst.

Regarding means of preserving copra, a few methods have been suggested. Thus in the *tapahan* system the creosote by-product of the destructive distillation of the shells and husks help in preserving the native copra, and it is because of the presence of this substance that copra with a moisture content of as high as 25-30 per cent may be allowed to stand for a few days without molding. In places where the desired product is white, artificial driers are used, and the copra is later subjected to SO₂ treatment. Observation in our laboratory and that of others shows that, as a preservative, SO₂ is very efficient. But the great drawback in the use of this substance is that where the oil is to be hydrogenated for edible purposes, the nickel catalyst is very easily poisoned by the presence of the sulfur compound.

Other chemicals have been suggested for copra preserving. Thus the use of boric acid was cited in the editorial in the *Agricultural Review* of September 18, 1909. Jarlien and Goonewardene (1926) proposed the use of alum, formaldehyde, potassium dichromate, chlorine, nitric acid, potassium permanganate and boric acid. The efficiency of these preservatives, however, has not been thoroughly tested.

EXPERIMENTAL METHODS AND RESULTS

It is evident from conclusion (2) of Brill, Parker, and Yates that in order to determine the proper critical molding moisture content of copra, the size of each piece must be of such dimensions as to assure a nearly uniform passage of water from the edge to the center. To secure this uniformity, the samples of copra used in this investigation were passed through a grinder, the particles being approximately three millimeters in diameter.

Furthermore, in order to minimize the effect of the relative humidity, and thereby to regulate the amount of moisture in the surrounding atmosphere (and consequently, the amount of water absorbed in the copra), the samples should be surrounded by different aqueous solutions each of definite vapor tensions; for this purpose different concentrations of solutions of electrolytes, such as NaOH and NaCl were used.

As preliminary experiments to determine the course of the water absorption by copra, and its consequent molding, copra samples were ground and dried to zero per cent moisture, then placed over water in closed desiccators and the increase in weight determined every day, the desiccators being, of course, opened to the air after each weighing. Invariably, the greatest increase came during the first day, the increase in weight becoming less and less with longer exposure, until the weight became constant for a short time and then started to decrease. Molds appeared before the weight became constant. From the analysis of the samples after long exposure to the water vapor, it was evident that the loss of weight was due to the loss of oil, fiber, and possibly proteins and sugars. In the chart, *a* shows the relation between increase in weight of dried ground copra and time of exposure to saturated water vapor. In the same chart, *b* shows the relation between the increase in weight of dried ground copra and the time of exposure to an aqueous solution of SO_2 .

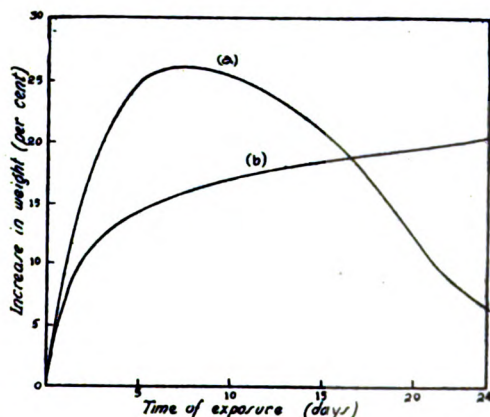


Chart 1.—Showing the change in weight of copra with exposure to saturated water vapor at room temperature.

TABLE 1

Comparison of the oil and acid contents of ground copra exposed to water vapor after different treatments

SAMPLE	LENGTH OF EXPOSURE TO WATER VAPOR	LOSS OF FIBER, OIL, ETC.	H ₂ O AND OTHER VOLATILE MATTER ABSORBED AT END OF EXPOSURE	OIL AND ACID IN DRIED MOLDED COPRA	ACID IN OIL (OLEIC ACID)
	days	per cent	per cent	per cent	per cent
A.....	34.6	33.2	46.0	30.5	43.0
B.....	31.6	35.0	36.4	25.7	19.2
C.....	16.0	15.2	40.2	28.9	19.4
D.....	165.0	1.4	120.0	55.5	1.1

Table 1 shows the results of analysis of dried ground copra exposed to water vapor in a desiccator. Sample A was taken from copra dried at 90°C. for 14.5 hours in a Freas electric oven, and was exposed to water vapor for 35 days. Sample B was taken from copra dried at 60°C. for 25 hours and exposed to water vapor for 32 days. Sample C was taken from copra dried at 60°C. for 39 hours and exposed to vapor for 16 days. Sample D was taken from copra dried at 60°C. for 24 hours and exposed to the vapor of an aqueous solution of SO₂ for 165 days. Before drying completely preparatory to exposure to saturated vapor², sample A had a moisture content of 7.3 per cent, sample B a moisture content of 7.4 per cent, sample C a moisture content of 4.8 per cent, and sample D a moisture content of 6.3 per cent. In samples A, B, and C, the molds appeared between the fourth and sixth days when the moisture content of the copra was around 20.2 per cent. In sample D no mold appeared throughout the entire exposure, the sample itself becoming rather bleached; on heating, however, the sample became very dark, and a loss in weight was observed. All percentages are expressed in terms of the dried copra.

While the speed of water absorption and the deterioration due to molds are much lower when the copra is left unground, it has been observed that this follows a course similar to that of the ground copra. It will also be noted from table 1 that there is no direct relation between the loss in fiber, oil, sugar, and protein on the one hand, and the acid formed on the other. Thus, while the loss in fiber, oil, etc., is 33 per cent, and the gain in acid is 43 per cent in sample A, in sample B the loss in weight is 35 per cent and the gain in acidity is 19 per cent.³

Since the vapor pressure of a pure solvent may be lowered by addition of any solute, advantage has been taken of this phenomenon to vary the vapor pressure of water surrounding different samples of copra. For this purpose the copra samples were placed over aqueous solutions of different concentrations of electrolytes, placed on metal gauze-covered dishes, the whole being covered by large funnels plugged with cotton wool on the stems; in this way, air can have access to the samples. In order to determine the equilibrium moisture content of the different samples exposed to these different vapor pressures, the ground copra was thoroughly mixed and two samples were placed inside each funnel. The samples were then weighed every day and the moisture content calculated on the dry basis. Any rancid odor or growth of mold was noted. At the end of a definite number of days, the samples were all dried at 100°C. to determine the loss in weight due to decomposition, and the oil and acid determined. Just before exposure, the moisture, oil, and acid contents of the whole sample were also determined.

²The temperature of the room varied from 24° to 29° C. throughout this part of the work.

³From our observations in conjunction with the Department of Plant Pathology of the optimum acidity condition for mold growth, we have found that the best growing condition for white, green, and brown molds is around pH 5.4 at room temperature.

TABLE 2

The course of water absorption of ground copra exposed to different aqueous tensions

TIME OF EXPOSURE	CHANGES IN WEIGHT OF COPRA BASED ON THE DRY WEIGHT, WHEN EXPOSED TO: ^a						
	Solid CaO	Saturated NaOH (20 N)	Saturated NaCl (5.5 N)	Normal NaCl	Normal H ₂ SO ₄	H ₂ O	Atmosphere
<i>days</i>	<i>per cent</i>	<i>per cent</i>	<i>per cent</i>	<i>per cent</i>	<i>per cent</i>	<i>per cent</i>	<i>per cent</i>
0	8.7	8.3	12.7	13.0	8.4	12.5	12.5
1	4.7	3.4	9.2	12.3	10.8	13.0	9.9
2 ^b	4.2	2.8	8.1	12.5	13.1	14.4	9.0
4	3.5	2.9	8.1	13.4	15.9	16.5	9.1
5	4.5	2.8	8.1	13.7	16.4	17.0	9.3
6	4.4	3.0	8.0	13.4 ^m	16.1 ^m	16.1 ^m	9.0
7	5.5	2.8	7.8	12.7	15.8	15.2	9.1
8	6.5	2.8	7.8	12.6	15.5	15.1	9.3
9	7.8	2.7	7.2	11.3 ^{hm}	15.7 ^{hm}	12.8	7.4
10							
11	8.1	2.6	7.8	11.3	14.9	11.6	8.6
12	8.4	2.6	7.7	11.1	14.2	10.2	8.1
13	8.0	2.6	7.7	11.1	13.4	9.9	8.4
14	7.4	2.6	7.7	10.5	11.9	8.5	8.3
15	7.2	2.7	7.3 ^{sr}	9.5	10.9	7.2	8.1 ^{sr}
16	—	—	7.9	9.5	—	6.9	8.5
Average moisture content...	6.3	2.8	7.8	—	—	—	8.6
Max. variation from average...	-2.5, +2.4	-0.2, +0.2	-0.6, +0.3	—	—	—	-1.2, +0.7

Chemical analysis after exposure

Loss of fiber, oil, etc., (per cent)	0.2	0.1	0.6	10.1	8.4	14.1	0.6
H ₂ O absorbed at end of exposure (per cent)	7.4	2.8	8.5	19.6	19.3	21.0	9.1
Oil and acid left (per cent).....	63.5	63.0	64.6	50.1	55.4	49.1	62.6
Acid produced (per cent).....	0.1	0.05	0.1	8.0	9.0	10.0	1.4

^a Average relative humidity of room throughout experiment = 78.5 per cent.^b Equilibrium seemed to be attained at second day.^m Molding was first observed.^{hm} Heavy molding first observed.^{sr} Slight rancid odor first observed.

Room temperature ranged from 21° to 29°C.

Table 2 shows the course of the absorption (or dehydration) from the atmosphere of different water vapor pressures in presence of the air, and the results of analysis after 16 days exposure. To maintain the different

pressures, the samples were exposed to solid CaO, saturated NaOH solution, saturated NaCl solution, normal H_2SO_4 solution, normal NaCl solution, tap water and to the atmosphere alone. All percentage calculations are based on the dry weight of the copra. At the end of each exposure, the samples were dried at 100° in an electric oven. The difference between this dried weight and the weight of the dry copra if no molding took place, which was determined at the beginning of each experiment, gives the loss in fiber, oil, protein, etc. The residual percentage in weight after each day of exposure does not necessarily indicate the percentage of water left after the exposure. In some cases, as has been pointed out, when molding and consequent decomposition takes place, the residual percentage is the difference between the percentage water actually present and the percentage loss in fiber, oil, etc. Hence, the percentage water actually present may be calculated from the loss in fiber, oil, etc., and the residual percentage after each day of exposure. At the end of the final exposure, each sample was transferred to a Soxhlet extractor, and the oil and acid determined in the ordinary way.

Table 2 shows that the equilibrium moisture content may be lowered to around 3 per cent with the method of exposure described. Since it was observed that molding does not take place with this moisture content for at least many months, saturated NaOH solution was diluted to different degrees, with the object of increasing the vapor pressure of the water below the samples of copra to be used, and thereby producing copra of different amounts of absorbed water. In this way it was thought that an accurate determination of the critical molding moisture content may be made.

Table 3 shows the different equilibrium moisture contents, the loss of weight after a definite number of days in the funnels, the oil content, the acidity and the number of days before molds appeared. The maximum variations from the average equilibrium moisture contents are also given. Percentages are expressed on the dry basis.

The materials used to maintain the different vapor pressures in table 3 are saturated NaOH, 15N, 10N, 5N, 4N, 3N, 2N, N, NaOH, and saturated (5.5 N) NaCl solution. To insure molding under the given vapor pressure conditions of water, white, green, brown, and black copra molds obtained from the Department of Plant Pathology were injected after 11 days into the first seven samples, when the weights appeared to be constant.

With the use as dilute of a solution as (5N) NaOH, corresponding to a moisture content of 8.0 per cent, no mold was noticed; in the case of the (4N) NaOH solution, a thin whitish mold was observed at the end of the twentieth day, while molds appeared on the thirteenth day with the use of the (3N) NaOH and earlier in the case of the more dilute solutions.

It will also be noticed from table 3 that even if the same concentration of the NaOH is used, the equilibrium moisture content of copra is not the same. This is explained by the fact that the external relative humidity is

TABLE 3

The relation between equilibrium moisture content of ground copra and its deterioration

	AVERAGE EQUILIBRIUM H ₂ O ^a	MAXIMUM VARIATION FROM AVERAGE		TOTAL LOSS OF WEIGHT After 40 days	OIL	ACIDITY IN OIL	NUMBER OF DAYS BEFORE MOLDS APPEARED	AVERAGE RELATIVE HUMIDITY ^b
		—	+					
	per cent	per cent	per cent	per cent	per cent	per cent		per cent
Sat. NaOH (20N)...	3.2	0.2	0.2	0.0	59.1	0.3	No molding	85
(15N) NaOH.....	4.4	0.4	0.3	0.1	57.9	0.5	"	85
(10N) NaOH.....	4.9	0.3	0.4	0.8	55.8	0.5	"	85
Sat. NaCl (5.5N)...	7.4	0.5	0.4	1.2	53.8	1.3	"	85
				After 25 days				
(5N) NaOH.....	8.0	0.6	0.5	3.0	51.6	1.3	No molding	81
(4N) NaOH.....	8.7	0.5	0.5	3.3	52.2	2.7	20	81
(3N) NaOH.....	9.5	0.9	0.8	5.9	44.3	10.7	13	81
(2N) NaOH.....				6.3	39.9	11.1	13	81
(N) NaOH.....				23.3	27.5	16.9	7	81
				After 25 days				
(7N) NaOH.....	7.1	0.2	0.3	0.0	61.7	1.1	No molds	87.5
(6N) NaOH.....	7.6	0.5	0.5	0.0	62.2	0.5	"	87.5
(5N) NaOH.....	9.1	0.5	0.9	0.2	61.6	2.7	21	87.5
				After 28 days				
(5N) NaOH.....	8.5	0.7	0.8	1.6	44.5	1.3	17	87
(4N) NaOH.....	9.4	0.4	0.3	3.7	41.9	9.0	13	87
(3N) NaOH.....	10.6	0.4	0.3	6.8	33.7	9.6	10	87
(2N) NaOH.....	11.7	0.7	0.8	8.0	30.6	12.2	10	87

^a Room temperature ranged from 26°C. to 33°C.^b The relative humidity was determined by the Department of Plant Physiology.

exceedingly variable and changes the concentration of the solution very rapidly, frequent changes of the solution being required to maintain even an approximately constant aqueous tension.

It would appear, however, that under an external relative humidity of 81 per cent, copra may be kept at least a month with a water content of 8 per cent (dry basis) without molding or acquiring a rancid odor. It may be pointed out that copra exposed to air of low relative humidity will not mold, and that it is only when the relative humidity of the air is so high that water is absorbed by copra and thus exceeds the 8 per cent limit, that molding occurs. It is also to be noted that although neither mold nor rancid odor were noticeable during the heating for moisture determination, greater losses were incurred in the samples exposed to higher aqueous tension.

TABLE 4

Comparison of the effects of different preservatives on ground copra

PRESERVATIVE USED	H ₂ O AND OTHER VOLATILE MATTER AT THE END OF EXPOSURE	OIL	ACID IN OIL (OLEIC)	COLOR OF OIL
	<i>per cent</i>	<i>per cent</i>	<i>per cent</i>	
Formaline	11.7	59.6	0.5	Light yellow
Furfural	9.5	64.2	3.5	Yellowish white
Boric acid	18.0	63.0	2.5	Dark yellow
Al ₂ (SO ₄) ₃ solid	33.1	79.7?	7.3	Reddish yellow
KMnO ₄ solution	37.4	42.2	2.4	Yellow
K ₂ Cr ₂ O ₇ solution	35.9	38.2	2.7	Yellow
HNO ₃ solution	32.7	43.8	4.7	Dark yellow
Over H ₂ O	42.0	47.1	2.3	Dark red
In air	6.4	52.9	0.5	Whitish

Table 4 gives the results of treating partially dried ground copra with different preservatives. Dilute solutions of KMnO₄, K₂Cr₂O₇, HNO₃ and H₃BO₃ were used. The formaline used was the 37 per cent solution. The Al₂(SO₄)₃ used was in solid form. All the treated samples were placed over water and enclosed in funnels, to insure maximum conditions for molding. At the end of seven days copra exposed to water alone, and copra first treated with Al₂(SO₄)₃, KMnO₄ solution, K₂Cr₂O₇ solution, HNO₃ solution, and boric acid acquired mold growths, the rancid odor appearing along before the mold. In copra treated with boric acid, very few molds appeared, and with the use of formalin and furfural, after more than a month, no molds had appeared.

In table 4 the acidity and oil content cannot be taken as good indices of the extent of damage done to the copra since in some cases acids have been added to the samples, and in other cases the preservatives are soluble in ether; furthermore, different samples containing different oil contents were used. The better indices of the extent of damage are the observed quantity of molds together with the water absorbed at the end of the exposure and the color of the oil. Using these as the bases for determining the best laboratory preservatives, it would appear that formalin and furfural are the best among the chemicals so far studied.

SUMMARY

1. The effects of different molds and micro-organisms on the deterioration of copra containing varied moisture contents and in presence of oxygen are reviewed.
2. The critical molding moisture content of ground copra under an external relative humidity of 81 per cent and at room temperature is found to be 8 per cent. Although no molding and no rancid odor is observed in

the case of some samples exposed to higher aqueous tension, the losses in weight after heating at 100°C. is not negligible.

3. Regarding copra preservation, it would appear that formalin and furfural have possibilities. The results of studies on the use of these and other substances on a semi-industrial scale will follow.

4. In addition to the method of preservation given in (3) the use in bodegas of solid NaCl which can maintain a relative humidity of about 73 per cent, or of solid NaNO₃, which can maintain about the same relative humidity, at ordinary temperatures, is suggested. The use of the substances is economical, since after complete solution, they can be easily recovered by evaporation.

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AN EXPERIMENT IN THE USE OF A GRAIN DRILL IN REDUCING THE COST OF PLANTING RICE¹

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WITH FOUR TEXT FIGURES

The rice imported in the Philippines in 1925, according to the Philippine Bureau of Commerce and Industry Statistical Bulletin for that year, amounted to 1,900,955 cavans (142,571,625 liters), valued at ₱12,826,439. The total production of rice in the Philippines for the same year was 22,231,041 cavans (1,667,328,075 liters) valued at ₱149,837,216.34, averaging ₱6.74 a

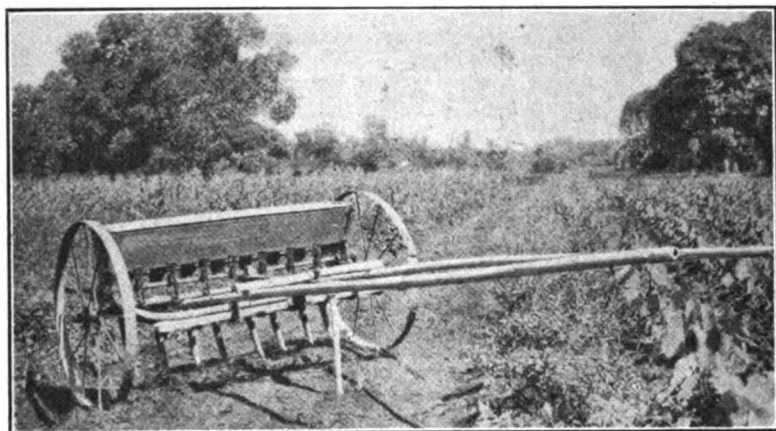


Fig. 1.—Climax Grain Drill as received by the College of Agriculture.
The double tongue is the only change made.

cavan. Assuming ₱2.93 to be the cost of producing a cavan of palay, basing this assumption upon the records obtained from the farmers in the neighborhood of the College of Agriculture at Los Baños and from the co-operators in the same College, the total cost of producing the 1925 crop was ₱130,273,900.26. Any suggestion on culture methods that will tend to reduce the cost of production will help reduce the capital invested per cavan for this purpose. This saving will increase production by making it possible to grow more rice because of the capital thus made available.

¹Experiment Station contribution No. 480. Read before the Los Baños Biological Club, September 1, 1927. Received for publication, September 26, 1927.

The main object of the investigation reported in this paper was to determine the possibility of lowering the cost of planting upland rice by ordinary methods with the native sowing implement and by using a modified standard imported grain drill.

MATERIALS AND METHODS

Climax grain drill

This drill is a standard grain drill imported from the United States; it bears the trade name "Climax". It has 8 spouts or rows, and the feed rollers are operated by 2 sprockets, one connected to the axle of the feed roller and the other one to the axle of the drive wheel. These two sprockets are connected by a sprocket chain. The amount of grain drilled per area of space is regulated by opening and closing the feeder slats. This drill

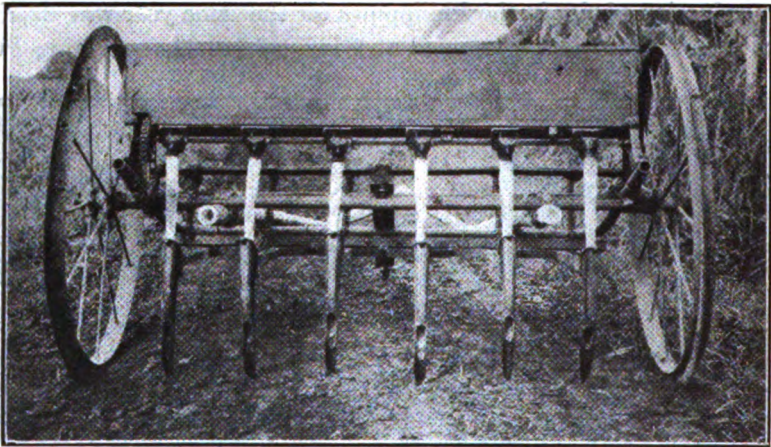


Fig. 2.—Climax Grain Drill after the improvements were made. Note the keel on the rim of the wheels which makes it run straight. The distance between the spikes are made wider also.

can be operated by one man and a bullock, by attaching to it a double tongue as shown in figure 1. The minimum amount of grain to the hectare that can be sown by this drill is about 35 gantas (105 liters), and the distance between the rows is about 17.78 centimeters.

The imported grain drill can not be used in the Philippines without making changes to adapt it to Philippine conditions, as for use here it has the following defects:

1. The least amount of seed it can plant per hectare without doing damage to the seed rice is about 32 gantas (96 liters), which is excessive.
2. The space between the rows is too narrow to accommodate the cultivator.
3. The drive-wheel has no guide or keel, thus it is impossible to make straight rows.

The first defect was remedied in the following way:

The operating part of the feeder of this drill, "Climax Grain Drill," consists of a driving sprocket gear having 6 teeth and a driven sprocket gear having 8 teeth. This driven sprocket gear is connected with the axle driving the grooved cylinder feeders. The only change that was made was to increase the number of the teeth of the driven sprocket gear from 10 to 16, thus reducing the revolution of the grooved cylinder feeder by about one-third. By this arrangement the amount of seed sown can be reduced to as low as 13 gantas (39 liters) to the hectare.

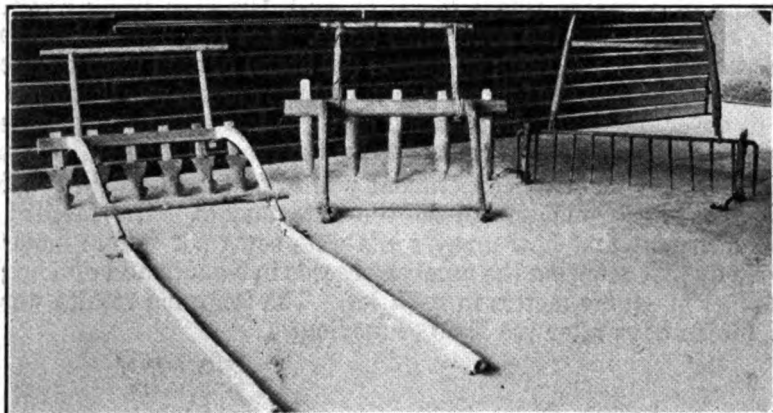


Fig. 3.—From left, first implements are lithaos. The first is an improvement on the second. Note the blade of the spikes made out of the blade of Acme weeding hoe, and the bamboo shafts instead of trace chains. These shafts steady the yoke which acts as a saw on the neck of the animal if trace chains are used. The third implement is an iron comb-tooth harrow.

In the neighborhood of the College of Agriculture, the standard distance between rows of upland rice which gives the best yield is 27 centimeters. As the standard grain drill has a distance of 17.78 centimeters, this distance was increased to 27 centimeters by changing the feed hopper and reducing the number of spouts from 8 to 6.

The drive wheels were improved by providing a keel or guide on each rim (see fig. 2).

To complete the outfit a double tongue made of bamboo was provided with a wooden yoke attached to one end.

Lithao

This is a native implement for marking the ground into furrows. It is shown in figure 3. In construction it is similar to the iron comb-tooth harrow as shown in same figure (3), only it is made of wood and the teeth are made from the trunk of Carryota palm. The lithao is about 1.12 meters

long and has five teeth. The teeth are about 30 centimeters long and are shaped like the blade of a spear. They are about 8 to 10 centimeters at the widest point.

EXPERIMENTS AND RESULTS

A portion of the Experiment Station ground, an area of approximately one and one-half hectares, was divided into three equal lots. Lot No. 1 was planted with the "Climax Grain Drill" on June 8, 1926, using 16 gantas (48 liters) of seed. The rows were about 27 centimeters apart. Lot No. 2 was marked with the lithao on June 7, 1926, and the seed sown the following day, using 37.3 gantas (111.9 liters) of seed, the seed being covered by running a harrow over the rows three times. Lot No. 3 was plowed ready for planting on June 7, 1926; 30 gantas (90 liters) of seed were broadcasted on the plowed ground the following day, and the ground was harrowed three times to cover the seed. In planting all three lots, the Inintiw variety of rice, giving 94.95 per cent germination by the rag-doll method, was used.

The first object of this experiment was to find, under field conditions, the difference in germination in the three treatments. The method used was to determine first how many seeds were sown per square meter; this was done by first counting the number of seeds in a ganta and dividing it by the number of square meters in each lot. The following results were obtained fifteen days after the time of seeding:

	<i>Percentage of germination</i>
Drilled.....	89.3
With lithao.....	66.1
Broadcasted.....	50.01

Each of these figures was the average of 20 different counts taken at random from each lot. These results show that 15 days after seeding the drill method gave 23.2 per cent better germination than the lithao and 39.29 per cent better than the broadcasted. Or, in terms of cavans, for every hundred cavans of seed used, the drill method used 23.2 cavans less than the lithao, and 39.29 cavans less than the broadcasted. In terms of pesos, at the rate of ₱4.00 a cavan, the drill compared with the lithao, saved ₱92.80, and compared with the broadcasted method, ₱157.16.

The second object of this experiment was to determine the amount of time required for one man and one animal with each of the implements used to plant a hectare. For the drill, with one man and one bullock it required 6 hours and 20 minutes. Basing calculations on the rate of 11.1 centavos an hour for both man and animal, the total cost was ₱1.405.

The lithao is an implement that cannot be handled by one man alone, hence to compute the cost, the different items in the procedure must be considered. These are:

For marking, two men and one bullock for 7 hours; for sowing seed, one man for 5 hours; for covering seed by harrowing twice, one man and one bullock for 12 hours and 30 minutes.

Using the same rate for one man and one bullock as with the drill method, that is, 11.1 centavos an hour, the total cost of operation was ₱5.66

With the broadcast method, the operations were itemized also: For plowing, one man and one bullock for 36 hours; for broadcasting, one man



Fig. 4.—Stand of rice planted with the improved grain drill. The stick is one meter long.

for 5 hours; for harrowing to cover the seeds, one man and one bullock for 16 hours.

The total cost of operation using the same rate as before, 11.1 centavos an hour, was ₱12.10.

Comparing the different costs of operation the data in table 1 were obtained:

TABLE 1

Giving the time, the number of men, the number of animals used and the total cost to plant a hectare, with each of the three methods

OPERATIONS	TIME TO PLANT A HECTARE	MEN RE- QUIRED	ANIMALS REQUIR- ED	TOTAL COST INVOLVED
	<i>hours</i>	<i>number</i>	<i>number</i>	<i>pesos</i>
Drill.....	6 $\frac{1}{3}$	1	1	1.405
Lithao.....	51	2	1	5.660
Broadcasted.....	105	1	1	12.100

The drill requires one man and one bullock 6 $\frac{1}{3}$ hours, with the total cost of operation of ₱1.405 or ₱4.255 less than that required by the lithao, and ₱10.695 less than by the broadcast method.

Summarizing these three operations, it will be noted that in planting a hectare of ground the drill has the following advantages:

In economy of seed used, the drill required 42.6 gantas less than the lithao and 28 gantas less than the broadcast—using 32 gantas for the drill and 74.6 gantas for the lithao and 60 gantas for the broadcasted.

Time and labor were saved also because the drill with one man and one bullock planted a hectare in six hours and twenty minutes, whereas the lithao required two men and one bullock about two and a half days to plant the same area; and the broadcast method required five men and four bullocks one day.

In cost of operation the drill was ₱4.255 cheaper per hectare than the lithao and ₱10.695 cheaper than the broadcasted. Summing up all of these savings, the drill had to its credit the amount of ₱11.081 compared with the lithao and ₱15.175 compared with the broadcasted. Or by using the same capital, with the drill method one can plant about 9 hectares to one hectare with the lithao and about 11.8 hectares to one hectare with the broadcast method.

These statements are sufficient to show the importance of using the drill instead of the old methods in planting upland rice.

RECOMMENDATIONS

For satisfactory service the following is recommended in using a rice grain drill:

1. Have a good mellow deep soil.
2. Do not drill the seed when the ground is wet.
3. Do not allow any trash to accumulate at the point of the spout.
4. Use a disc furrow opener, if obtainable, but never use a shoe type furrow opener.

EFFECTS OF SUNLIGHT ON THE HATCHING QUALITY OF EGGS¹

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WITH ONE TEXT FIGURE

The hatchers of duck eggs in the mammoth incubators in Pateros, Rizal Province, have for generations practiced the sunning of duck eggs prior to placing them in the large native incubators. (Raymundo, 1912; Burgos, 1924; Fronda, 1925-26.) Their object in doing this is to save the labor involved in the preliminary heating of the eggs. Although many new discoveries on the good effects of sunlight upon the growth and reproduction of animals have been reported, these hatchers are not aware of any such beneficial effects of direct exposure of eggs to sunlight upon their hatchability.

Following the suggestion that came to mind from this old practice of the hatchers of duck eggs in Pateros, a study was conducted by the senior author in 1925, using duck eggs hatched artificially. One-half of the number of eggs incubated were exposed to direct sunlight for fifteen to thirty minutes daily for the first fourteen days of incubation. The results obtained from this brief study were very significant. For this reason, more extensive trials were subsequently conducted.

REVIEW OF LITERATURE

There has been a considerable amount of literature published on the beneficial effects of sunlight on the cure and prevention of rickets, commonly called leg weakness among chickens, and on the growth and reproduction of organisms (Park, 1923). Only recent publications that have some direct bearing on this problem were consulted and are here reviewed.

Hughes, Payne, and Latshaw (1925) conducted experiments to determine the effects of ultra-violet light, either from the sun or from a mercury quartz lamp, on leg weakness of chicks, on the egg production of hens and hatchability of the eggs produced. From the results obtained they concluded, in part, that ultra-violet light will prevent leg weakness in growing chicks and that it has a marked beneficial effect on egg production and the hatchability of the eggs produced. These workers claimed that the variation in the hatchability of the eggs produced by hens receiving various

¹ Mr. Belo used the major part of the data herein reported in a thesis presented by him for graduation from the College of Agriculture, University of the Philippines, October, 1927. He was responsible for the incubation tests carried on from June, 1926, to April, 1927.

Thesis No. 259; Experiment Station contribution No. 481.

amounts of ultra-violet light was perhaps due to a variation in the antirachitic vitamin content of the eggs. Hughes, Payne, Titus, and Moore (1925) reported that the amount of ultra-violet irradiation which a hen receives is an important factor in determining the antirachitic vitamin content of the eggs which she produces, when her feed is low in the antirachitic vitamin. They also found that eggs which have a low antirachitic vitamin content do not have as high a hatchability as eggs having a high content of this vitamin, other factors influencing hatchability being constant. In a report of Hart, Steenbock, Lepkovsky, Kletzien, Halpin, and Johnson (1925), the statement is made that ultra-violet light greatly influenced the egg production of the hens exposed to it. The hatchability of the eggs produced was also greatly improved, while the fertility of the eggs was not consistently influenced by an abundance of the antirachitic factor. Direct exposure of the eggs to ultraviolet light, however, "had no influence whatever on the hatchability of the eggs, nor had it killed the living embryo".

In 1923, Herrick, Ackert, and Danheim stated that light, roomy, well-ventilated pens with clean straw litter are valuable assets in keeping chickens active and healthy. Kennard (1925) claimed that much of the benefit derived from having the birds out of doors is due to direct sunlight that they receive; these direct rays promote the health of the flock and also they appear to be essential for good hatchability of the hen's eggs. Hughes (1926) maintained that the lack of direct sunshine and not the lack of exercise on the soil is the cause of leg weakness when chicks are kept in the brooder house. He also claimed that the lack of direct sunshine is one of the causes of poor hatches in the early spring. These facts he explained by pointing out that vitamin D is developed in an animal when ultra-violet rays of the sun shine upon its skin.

Gowen, Murray, Gooch, and Ames (1926) reported that chickens that were fed milk from cows exposed daily from fifteen to thirty minutes to ultra-violet light remained in good condition. They also found that more of the substance necessary to cure rickets is absorbed by the cow exposed to ultra-violet light and secreted by her in her milk. Steenbock, Hart, Hoppert, and Black (1925) reported that by exposure to the radiations of a quartz mercury vapor lamp, the antirachitic properties of cow's milk were increased eight or more times, and under the same conditions, a sample of goat's milk increased in activity about twenty-four times. They also found that this increase in activity could be induced rather promptly, though to a lesser degree, by direct irradiation of the animal.

To determine the factor responsible for the prevention and cure of leg weakness in chicks, Bethke, Kennard, and Kik (1925) of the Ohio Agricultural Experiment Station, in an experiment with White Leghorn chicks, found that direct sunlight proved effective as an antirachitic agent. Their results show that one-half hour of direct sunlight is more effective than

green clover in preventing leg weakness in chicks. The authors concluded that the benefit in turning chicks out of doors to prevent or cure leg weakness is mainly due to the effect of radiant energy supplied by direct sunlight. Again, Ackerson, Blish, and Mussehl (1925), in studies also with White Leghorn chicks, at the Nebraska Experiment Station, found that a supplement of direct sunlight prevented the occurrence of rickets in chicks which were normal as far as growth was concerned.

Hughes (1924) reported that young chicks receiving a standard scratch feed and mash supplemented with sprouted oats and fresh butter-milk developed rickets if they were kept in a room where the light is filtered through glass, while those receiving the same treatment but exposed to direct sunlight a few hours each day developed normally. Working on experimental rickets, Hess, Unger, and Pappenheimer (1922) found that the effect of fifteen minutes daily exposure to sunlight was about equivalent to doubling the protective dose of phosphorus in rats. Hart, Steenbock, Lepkovsky, and Halpin (1923) reported that light acts as a supplement or the equivalent to the antirachitic factor of food stuffs in raising baby chicks. They also reported that an abundance of sunlight or irradiation by ultra-violet light electrically produced will prevent leg weakness.

It has been reported also that sunlight has a curative effect on rickets among infants (Hess and Unger, 1921). Later, Hess and Gutman (1921), also working on the cure of infantile rickets, found that sunlight not only brings about a cure of rachitic lesions, but also occasions chemical changes in the blood similar to those noted when the cure is effected by cod-liver oil. Again, Chick, Dalyell, Hume, Mackay, and Smith (1922), all of the Vienna University Kinderklinik, working on the etiology of rickets in infants, found that the cure was most marked in cases receiving cod-liver oil and exposure to sunlight simultaneously. In cases where no cod-liver oil was used the rate of bone healing was proportional to the amount of exposure.

That the egg yolk has marked antirachitic properties for both animals and infants has been repeatedly shown (Hess, 1923; Casparis, Shipley, and Kramer, 1923; Hughes, Payne, Titus, and Moore, 1925; Hart, Steenbock, Lepkovsky, Kletzien, Halpin, and Johnson, 1925; and Heuser and Norris, 1926). But Heuser and Norris (1926) expressed the opinion that it is probable that the antirachitic potency of eggs is influenced by seasonal variations in the amount of sunshine and conditions of confinement, for the same reason that the vitality of chicks varies widely with the season of the year in which the eggs are laid. In this connection it has been reported by Hart and his associates (1925) that the antirachitic potency of yolks of eggs produced by hens that have been irradiated is increased to about ten times that of egg yolks from non-irradiated hens. Similarly the studies of Steenbock, Hart, Elvehjem, and Kletzien (1925) have conclusively proved that the antirachitic properties of eggs are related to their exposure to sunlight.

It has been reported that even foods containing lipoidal properties can be endowed with specific antirachitic potency by ultra-violet irradiation. Steenbock and Nelson (1924-25) reported that a ration which induced rickets in the rat has been made antirachitic by the simple exposure of it to ultra-violet light. Hess and Weinstock (1924-25) and Hess (1925) reported that cottonseed oil, linseed oil, and even green tissues had been made antirachitic by irradiation. These materials before treatment do not have any antirachitic values. Again, Steenbock and Daniels (1925) reported success in thus activating such foodstuffs as lard, butterfat, olive oil, coconut oil, cottonseed oil, and corn oil. Hess and Weinstock (1925) stated that wheat which has been irradiated by ultra-violet light retains its antirachitic potency for weeks. In a later report, Hess, Weinstock, and Helman (1925) added phytosterol prepared from cottonseed oil, cholesterol, a crystalline preparation extracted from brain tissue, and lanolin as substances that have been made antirachitic by irradiation with the quartz mercury vapor lamp. However, Mussehl, Hill, and Rosenbaum (1926) reported that irradiation of fresh corn oil for thirty to sixty minutes only slightly enhanced its antirachitic property. They further stated that irradiation of yellow corn and white corn for thirty minutes before grinding did not enhance to any appreciable degree their antirachitic values. The trials of these authors were made on chicks given a ration complete except for the antirachitic factor.

All of these observations point out that vitamin D (antirachitic vitamin) is developed in an organism when ultra-violet rays of the sun shine on its skin. Also, this vitamin is developed inside products containing lipoidal substances when these are exposed to ultra-violet rays. Different investigators on the mineral metabolism of an animal have shown also that exposure either to sunlight or to quartz mercury vapor lamp improves the calcium assimilation, and thus a positive calcium balance is produced in an animal. Hart and his associates (1924) showed that lactating goats in a negative calcium balance on a ration deficient in antirachitic factor, when irradiated ten to twenty minutes daily by quartz mercury vapor lamp would be put in a positive calcium balance. In a later report Hart and his co-workers (1926) gave findings that showed that direct exposure of cows to sunlight improved the utilization of calcium, and this treatment was instrumental in bringing about equilibrium in cows producing twenty-five to thirty pounds of milk. Maynard, Goldberg, and Miller (1925) concluded in their study on the influence of sunlight on bone development in swine that sunlight has a marked influence on the mineral metabolism of growing pigs that are fed a ration low in calcium and presumably low also in the factor aiding calcium assimilation. They observed also that sunlight increased the ash content of the bones, and, in general, the pigs exposed to sunlight had bones more normal than had those raised indoors. Similarly Bohstedt, Bethke, Edgington, and Robison (1927) reported that pigs on a ration deficient in calcium salts and in vitamins A and D made

better gains and grew denser and stronger bones when exposed to direct sunlight than pigs on the same rations but kept indoors. Steenbock, Hart, and Jones (1924) also reported that direct sunlight improved the mineral metabolism and stimulated the growth of pigs.

The most direct report found along this line with eggs is that of Hart and his associates (1925) in which they observed that the amount of lime in the shell is increased markedly by irradiation of hens. They also reported that the calcium content of the developing embryo at twenty-one days is nearly twice as much as the embryo from non-irradiated hen's eggs. Again, Ackerson, Blish, and Mussehl (1925) found that chicks receiving cod-liver oil additions or direct sunshine have sera that have slightly higher contents of calcium and inorganic phosphorus than with chicks where the antirachitic factor was withheld. In connection with this, it may be well to call attention to the claim of Riddle (1924) that in pigeons one of the functions of the thymus is to govern the disposition of the shell and the albumen of the egg. For this hypothetical hormone, he proposed the name *thymovitin*. Collip (1925), however, has obtained a powerful extract of the parathyroid by which it is possible to increase the calcium content of the blood to any desired degree. These two later reports are of value in correcting the impression that vitamin D and light are the all-important factors in calcium metabolism.

On the other hand, the works of Hart and co-workers (1921; 1922; 1923; 1924) point out that a vitamin or the vitamins that are present in green plants and in properly cured hays assist in the assimilation of calcium and phosphorus. They showed that cattle can utilize calcium and phosphorus more efficiently when the ration contains fresh green plant tissues, and for this reason, they believe that this effect of green plant tissues is due to the presence of antirachitic vitamin which is less active in dry hays. Thus, in the opinion of these investigators, a good assimilation of calcium results in the presence of the antirachitic vitamin, which can be developed in the food on exposure to sunlight, or when irradiated by quartz mercury vapor lamp. However, Hunt, Winter, and Miller (1923) also have shown that "possibly the difference between green and dry hay in causing a difference in the assimilation of calcium is partly due to the difference in the physical properties (fineness of division) of the cell content of the two hays, and therefore a difference in the digestibility."

OBJECT OF THE PRESENT WORK

While these numerous reports show that direct sunlight has marked beneficial effects, the effects on hatching eggs when exposed directly to sunlight have not been determined. The object of this work was to determine the effects on the hatchability of exposure of hatching eggs to direct sunshine. Also an endeavor was made to find out just how much exposure

to sunlight will produce the best effects on the hatching quality of the eggs, and thus determine whether or not sunning of the hatching eggs during the incubation processes would be profitable if put into actual practice.

The work was conducted in the Department of Animal Husbandry, College of Agriculture, University of the Philippines, at Los Baños, Laguna. It was begun in August, 1925, and closed April, 1927.

MATERIALS AND METHODS

Materials

The materials used in this work were 114 duck eggs, and 1267 chicken eggs, a 250-hot water Queen incubator, and pedigree bags.

Methods

Artificial incubation was employed throughout. Six settings in all were made. One hundred and fourteen duck eggs were used in the first setting, which was a trial setting, and made in August 1, 1925. The eggs were divided into two lots, lots 1, and 2. In lot 1, the check lot, there were 57 eggs; in lot 2, the experimental lot, there were also 57 eggs; this lot received sunlight treatment fifteen to thirty minutes daily during the first fourteen days of incubation.

TABLE 1
*Showing hatching results with duck eggs
(First setting)*

	LOT 1 (UNSUNNED)	LOT 2 (SUNNED)
Number of eggs set.....	57	57
Number of infertile eggs.....	1	2
Percentage D_1^a	1.79 ^b	7.27 ^b
Percentage D_2^a	5.36	0.00
Percentage D_3^a	51.78	41.81
Percentage pipped.....	1.79	0.00
Percentage hatched.....	39.28	50.91

^aEggs, germs of which died during the first and second testings, and those that did not hatch at the end of the incubation period.

^bAll percentages are based on fertile eggs.

The second setting was made June 20, 1926. Two hundred and sixty-seven chicken eggs were used in this setting. The eggs were divided into lots 1, 2, 3, 4, and 5. In lot 1, the check or the unsunned lot, there were 57 eggs; there were 57 in lot 2; 57 in lot 3; 51 in lot 4; and 51 in lot 5. Lots

2, 3, 4, and 5 were the experimental lots and received sunlight treatment as follows:

Lot 2 was sunned thirty minutes just before placing the eggs in the incubator,

Lot 3 was sunned thirty minutes immediately before placing the eggs in the incubator and thirty minutes every six days thereafter until the eighteenth day of incubation.

Lot 4 was sunned thirty minutes just prior to placing the eggs in the incubator and thirty minutes every three days thereafter until the eighteenth day of incubation.

Lot 5 was sunned thirty minutes immediately before placing the eggs in the incubator and thirty minutes every day thereafter until the eighteenth day of incubation.

TABLE 2

Showing results of the second setting

LOT NO.	NUMBER EGGS SET	NUMBER FERTILES	D ₁ ^b		D ₂ ^b		D ₃ ^b		PIPPED		HATCHED	
			Number	Percentage ^c	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
1	57	55	11	20.00	10	18.18	9	16.36	2	3.64	23	41.82
2	56 ^a	49	8	16.33	6	12.24	11	22.45	2	4.08	22	44.90
3	51	43	8	18.60	3	6.98	5	11.53	1	2.33	26	60.47
4	51	47	5	10.64	5	10.64	4	8.51	1	2.13	32	68.09
5	50 ^a	47	9	19.15	2	4.25	6	12.77	0	0	30	63.83

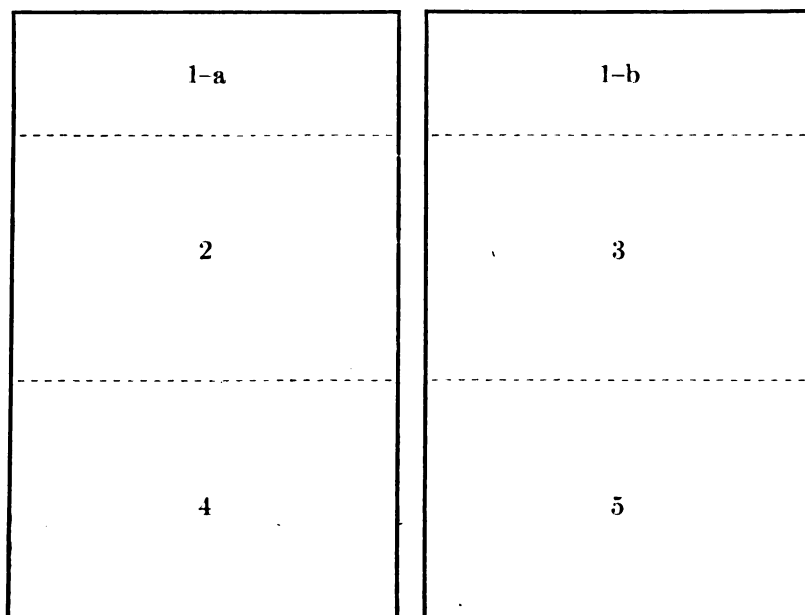
^a One egg from each of these lots was accidentally broken. Such eggs were deducted from the total number in the lot and considered as if not set at all. They were broken during the process of candling.

^b Eggs, germs of which died during the first, second, and third weeks of the incubation period.

^c All percentages are based on fertile eggs.

All the eggs in the lots were set in the same incubator. The incubator had two egg trays, and in the first setting, one lot was placed in one tray and the other lot in another tray. In the subsequent settings, lot 1, the check lot, was divided into two sub-lots and one sub-lot was placed in each egg tray. The eggs were turned twice a day and the places of the egg trays were interchanged, the idea being to subject, so far as possible, all the lots to the same conditions in the incubator. Figure 1 shows the two egg trays and the way they were partitioned. The broken lines represent the bamboo

partitions, separating the lots from each other. Sub-lots 1-a and 1-b constitute the check lot while lots 2, 3, 4, and 5 represent the experimental lots.



Scale 1:66.37

Fig. 1.—The two egg trays; showing how they were partitioned.

Sunning. When the eggs in the experimental lots were to be exposed to direct sunlight, the two egg trays were removed from the incubator and placed on a table in the incubator cellar. The eggs to be sunned were transferred to a third tray and at once exposed to direct sunlight, while those not to be sunned were returned to the incubator. After the process

TABLE 3
Showing results of the third setting

LOT NO.	NUMBER EGGS SET	NUMBER FERTILES	D ₁		D ₂		D ₃		PIPPED		HATCHED	
			Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
1	49 ^a	41	17	41.46	1	2.44	4	9.76	2	4.88	17	41.46
2	50	43	11	25.58	2	4.65	2	4.65	1	2.33	27	62.79
3	50	45	12	26.67	3	6.67	10	22.22	1	2.22	19	42.22
4	49 ^a	45	10	22.22	1	2.22	4	8.89	0	0	30	66.67
5	50	46	9	19.56	2	4.35	5	10.87	0	0	30	65.22

^a One egg from each of these lots was accidentally broken during incubation. Such eggs were deducted from the total number in the lot and considered as if not set at all. They were broken during the process of candling.

TABLE 4
Showing results of the fourth setting

LOT NO.	NUMBER EGGS SET	NUMBER FERTILES	D1		D2		D3		PIPPED		HATCHED	
			Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
1	50	47	6	12.77	2	4.26	3	6.38	3	6.38	33	70.21
2	50	44	4	9.09	2	4.55	4	9.09	2	4.55	32	72.73
3	50	46	4	8.69	2	4.35	10	21.74	0	0	30	65.22
4	50	46	5	10.87	2	4.35	4	8.70	1	2.17	34	73.91
5	50	42	3	7.14	2	4.76	3	7.14	0	0	34	80.95

of sunning, the two egg trays were again removed from the incubator and the treated eggs transferred at once to them and returned to the incubator. It may be mentioned here that with great care in the process of sunning no egg need be broken. In this experiment not a single egg thus handled was broken; the few broken eggs reported were damaged in the process of candling.

The third setting was made on December 1, 1926, the fourth on January 7, 1927, the fifth on February 1, 1927, and the sixth on April 5, 1927. In each of these settings 250 Cantonese eggs were used. The eggs in each of the last five settings were divided into five lots, taking all possible care that the eggs were divided equally as to age.

Testing. On the seventh day of each setting, the eggs were candled and the infertiles and those having dead germs were removed. All the infertile and doubtful eggs were broken into a saucer to determine accurately whether they were really infertile or had germs that died very early. Thus real infertility and not "apparent infertility" was determined. On the fourteenth day of incubation, the eggs remaining in the incubator were again candled. In all cases, the eggs were numbered before setting. On the twenty-seventh day of incubation in the case of the duck eggs, and on the eighteenth day in the case of all chicken eggs, these were put in pedigree bags so as to be sure that the chicks did not get mixed when the hatch was completed.

RESULTS

Careful records were made of all eggs set: in duck eggs of infertile eggs, embryonic mortality in the first, second, third, and fourth weeks, and the ducklings that hatched; and in chicken eggs of infertile eggs, embryonic mortality in the first, second, and third weeks, pipped eggs, and the chicks

that hatched. The results of the six settings are shown in tables 1, 2, 3, 4, 5, and 6. Table 7 shows the average percentage of embryonic mortality

TABLE 5

Showing results of the fifth setting

LOT NO.	NUMBER EGGS SET	NUMBER FERTILES	D1		D2		D3		PIPPED		HATCHED	
			Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
1	50	46	6	13.04	4	8.70	7	15.22	1	2.17	28	60.87
2	50	47	5	10.64	1	2.13	11	23.40	0	0	30	63.83
3	50	43	6	13.95	1	2.33	6	13.95	0	0	30	67.77
4	50	44	2	4.55	1	2.27	8	18.18	1	2.27	32	72.73
5	50	41	3	7.32	1	2.44	8	19.51	0	0	29	70.73

TABLE 6

Showing results of the sixth setting

LOT NO.	NUMBER EGGS SET	NUMBER FERTILES	D1		D2		D3		PIPPED		HATCHED	
			Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
1	50	46	4	8.70	3	6.52	7	15.22	0	0	32	69.56
2	50	45	2	4.44	1	2.22	6	13.33	1	2.22	35	77.78
3	50	47	2	4.26	2	4.26	7	14.89	0	0	36	76.60
4	50	46	3	6.52	0	0	2	4.35	0	0	41	89.13
5	50	46	2	4.35	2	4.35	3	6.52	0	0	39	84.78

during the first, second, and third weeks including the pipped eggs in each lot in the trials in which only chicken eggs were used. Table 8 shows the average percentage of hatch of these same lots together with the corresponding probable errors. The formula used in computing the probable errors was Bessel's² (Mendiola, 1925).

DISCUSSION OF RESULTS

Hatchability

In the first trial, a significantly higher percentage of hatch was obtained from the sunned lot than from the unsunned. In the second, third, fifth, and sixth settings, the highest percentage of hatch was obtained in lot 4, the lot which was sunned thirty minutes prior to being put in the incubator and thirty minutes every three days thereafter until the eighteenth day. In the fourth setting, however, the best hatch was obtained in lot 5, the lot

²This formula is as follows:

P. E. (Probable error of mean of several items) = $\pm 0.6745 \sqrt{\frac{\sum d^2}{n(n-1)}}$ in which d refers

to the deviation of the different items from their mean; n the number of items and $\sum$ shows that the values d^2 are to be added. In determining the probable error of the difference the formula used was $\pm \sqrt{A^2 + B^2}$, in which A represents the probable error of one mean and B that of the other.

which was sunned thirty minutes prior to setting in the incubator and thirty minutes every day thereafter until the eighteenth day. In the second, third, fifth, and sixth settings, lot 1, the check lot, gave the lowest percentage of hatch. In the fourth setting, however, the lowest percentage of hatch was in lot 3, the lot which was sunned for thirty minutes before setting and thirty minutes every six days, thereafter. Perhaps the reason for this result was the rather poor sunning this lot received; as the days were cloudy, all four sunnings, except the first, were poor. Lots 4 and 5 were exposed to sunlight at the same time that lot 3 was exposed, but they received good sunning at other times when lot 3 was not exposed.

Table 7 gives the summary of the last five hatchings in terms of average percentages. As shown in this table, lot 2 and lot 3 gave better hatchability than lot 1, the check. The probable errors of the differences were

TABLE 7

Showing the distribution of embryonic mortality in the last five settings only

LOT NO.	TOTAL NUMBER OF EGGS SET	TOTAL NUMBER OF FERTILE EGGS	PERCENTAGE EMBRYONIC MORTALITY				TOTAL
			D ₁	D ₂	D ₃	Pipped	
1	256	235	19.19	8.02	12.59	3.41	43.21
2	256	228	13.22	5.16	14.58	2.64	35.60
3	251	224	14.43	4.92	16.89	0.91	37.15
4	250	228	10.96	3.90	9.73	1.31	25.89
5	250	222	11.50	4.03	11.36	0	26.89

computed and it was found that in each of these cases the difference was not large enough to be significant. From lots 4 and 5 the best results were obtained, the difference between their hatchability and that of the check lot are significant, being 17.33 ± 5.09 per cent for lot 4 and 16.32 ± 5.16 per cent for lot 5, and for lot 4, 3.4 times its probable error, for lot 5, 3.2 times. Lot 4 had a higher percentage of hatchability than lot 5. Sunning eggs for thirty minutes every three days until the eighteenth day of incubation might be considered better than sunning eggs every day for the same period, as less labor is required and there is a slight difference in percentage of hatchability in favor of the sunning every three days.

From the results obtained it appears that sunning eggs thirty minutes prior to setting in the incubator and every three days thereafter, as well as every day until the eighteenth day of incubation, has pronounced favorable effects in increasing their hatchability. As has been stated elsewhere, vitamin D may have developed when ultra-violet light shone upon the eggs exposed. Also, as claimed by other investigators, it is evident that some active principle, which was presumably vitamin D, may have been developed in the eggs during the process of sunning, and this active principle favored the growth and development of the embryo chicks inside, hence better hatchability resulted. As has been observed by Hart and his associates

(1925), by Ackerson, Blish, and Mussehl (1925), and by Bohstedt and co-workers (1927), this direct exposure of the eggs to sunlight may have aided in the assimilation of calcium from the egg shells. As claimed in the investigations of Hart and his associates, the presence of the antirachitic vitamin, vitamin D, may have materially influenced this increased calcium assimilation from the egg shells of the sunned eggs. Whether or not this is the case, it is very evident that the more direct sunning the eggs received, the better was the hatchability of these eggs. These results differ from those obtained by Hart and his associates (1925) who observed that direct exposure to ultra-violet light had no influence whatever on the hatchability of the eggs. Hess (1925) also stated that even the tenuous skin that surrounds the hen's egg seems to intercept the progress of the ultra-violet rays to a greater or less degree.

Embryonic mortality

In the first setting, the percentage of embryonic mortality was higher in lot 1, the unsunned lot, than in lot 2, the sunned lot. In the second setting, it was highest also in the unsunned lot and lowest in lot 4, the lot which was sunned for thirty minutes just prior to setting and every three days thereafter until the eighteenth day of incubation. The results of the third setting show that the percentage of embryonic mortality was again highest in lot 1, the unsunned lot, and lowest in lot 4. In the fourth and sixth

TABLE 8

Showing average percentage of hatchability of the last five settings

LOT NO.	PERCENTAGE HATCHED	DIFFERENCE BETWEEN EXPERIMENTAL AND CHECK LOTS	PROBABLE ERROR OF DIFFERENCE	CHANCES
1	56.78 ± 4.32	—	—	—
2	64.41 ± 3.79	+ 7.63	± 5.66	Insignificant
3	62.86 ± 3.91	+ 6.08	± 5.83	Insignificant
4	74.11 ± 2.69	+ 17.33	± 5.09	Significant
5	73.10 ± 2.83	+ 16.32	± 5.16	Significant

settings, embryonic mortality during the first two weeks of the incubation period was again highest in the unsunned lot. In the fourth setting, however, embryonic mortality during the first week was highest in the lot which was sunned every six days and next highest in the unsunned lot.

During the third week of the incubation period, embryonic mortality in the second setting was highest in lot 2, the lot which was sunned just before setting, and lowest in lot 4. In the third setting it was highest in lot 3, the lot which was sunned every six days, and lowest in lot 2. In the fourth setting it was highest in lot 3 and lowest in lot 5, the lot which was sunned daily until the eighteenth day of incubation. In the fifth setting the embryonic mortality was highest in lot 2 and lowest in the unsunned lot, but in the sixth setting it was highest in lot 1 and lowest in lot 4.

It is interesting to note that in all of the last five settings there was no pipped egg in lot 5, the lot which was sunned daily until the eighteenth day of the incubation period. On the other hand, the average percentage of pipped eggs in lot 1 was 3.41 per cent; in lot 2, 2.64; in lot 3, 0.91; and in lot 4, 1.31 per cent.

Table 7 shows the distribution of embryonic mortality in the last five settings. As may be seen in this table, the average percentage of embryonic mortality during the first two weeks of the incubation period was highest in the unsunned lots and lowest in the lots that were sunned either every three days or daily. During the third week of the incubation period, however, the average percentage of mortality was found to be highest in the lot which was sunned every six days and lowest in the lot which was sunned every three days. The average percentage of embryonic mortality during the third week was found to be higher in lots 2 and 3 than in lot 1, the unsunned lot. The average embryonic mortality during the first two weeks of incubation was high in the unsunned lot and in the lots which were sunned not more than once every six days. The beneficial effects derived from sunning eggs in the process of incubation seem to be especially marked during the first two weeks of embryonic development. The influence of sunning on the third week of incubation is not very marked, but its effect on the percentage of pipped is rather significant. As has already been stated elsewhere, some active principle, presumably vitamin D, may have been developed among the sunned eggs and was responsible for their better hatchability. As has also been mentioned, the presence of this active principle may have materially increased the vitality of developing embryo chicks, and consequently lowered the percentage of embryonic mortality. Also, the presence of this principle may have brought about a better assimilation of the calcium in the egg shells, thus promoting the better development of the bony tissues and making the chicks stronger to break through their egg shells at hatching time. The absence of pipped eggs in the lot that received the most exposure to sunlight, and the almost insignificant number in the other lots that received slightly less sunshine may have been due to this. However, only actual analysis of the chicks at the time of hatching could show this, and on this phase of the work, we are not ready to report.

The slight difference in temperature to which the eggs were subjected when being exposed to sunlight and when not exposed at all may have had some effect on these differences in hatchability and embryonic mortality. Hess (1922) in his paper on the influence of light in prevention and cure of rickets stated that the protective action of light waves in the prevention of rickets cannot be attributed to temperature; however, his statement was perhaps not justified in the experiment. Hess, Unger, and Pappenheimer (1922) in their study on the cure of rickets found that "fully as great protection was afforded at 18°C. as at 29°C., almost no rickets developing in groups of rats exposed at either temperature." Powers, Park, and Sim-

monds (1923) state in this connection that it is possible that temperature has little influence on the process by which calcium salts are deposited in the bone. Their studies on the effect of radiant energy on xerophthalmia brought out the remarkable fact "that sunlight and out-of-door air with such factors as may be associated with them have wonderful health and life-giving powers which enable the animal to adapt itself with a considerable degree of success to adverse environmental conditions." In their opinion sunlight and out-of-door air supply something which raises the level of cellular function. It is very possible that this something that these investigators claim is supplied by sunlight and out-of-door air is the antirachitic vitamin, as claimed by the various investigators previously cited. Hughes, Nitcher, and Titus (1925), in comparing the values of ultraviolet light and irradiated air in preventing rickets, arrived at the conclusion that "the beneficial action of ultra-violet light in preventing rickets in chickens is due to its direct action on the chickens and not to changes which it produces in the air the chickens breathe." The observations of Nelson and Steenbock (1925) also confirmed this view; they concluded that no valid evidence was obtained to show that irradiation with ultra-violet light will confer growth-promoting or antirachitic properties on air.

SUMMARY OF CONCLUSIONS

1. The unsunned lots gave the lowest percentage of hatch.
2. Sunning eggs just before placing them in the incubator without subsequently repeating the operation, as well as sunning them just before placing in the incubator and every six days thereafter until the eighteenth day of incubation, produced no significant increase in the percentage of hatch over eggs that were not sunned.
3. Sunning eggs prior to placing them in the incubator and either every day or every three days thereafter until the eighteenth day of incubation, resulted in a significant increase in percentage of hatchability.
4. The average embryonic mortality during the first two weeks of incubation was high in the unsunned lot and in the lots that were sunned not more than once every six days during the incubation period.
5. Sunning the eggs either every three days or daily resulted in a significantly lower percentage of embryonic mortality during the first two weeks of incubation, than with unsunned eggs.
6. The beneficial effects derived from sunning eggs in the process of incubation seem to be especially marked during the first two weeks of embryonic development.
7. The total embryonic mortality was lowest in the lots that were sunned every three days or daily.
8. Sunning eggs every three days may be considered better than sunning eggs every day, as much labor is thereby saved.

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ABSTRACT

A study of the cost of production and distribution of income of tobacco in Ilagan, Isabela. ULPIANO V. MADAMBA. (*Thesis presented for graduation, 1924, from the College of Agriculture No. 260; Experiment Station contribution No. 482*).—The survey was made during the early part of 1923. The cost of production work was carried out in three typical barrios (Fugu, Capu, and Bañgac) of Ilagan, Isabela, and covered 100 farms. The cost of production was determined by a close analysis of the various farm operations. To facilitate the taking and recording of the necessary data, prepared questionnaires were carried with the investigator on his visits to the farmers. The data on cost of marketing and transportation of the product from Aparri to Manila were taken in Aparri, Cagayan, and also in Ilagan, Isabela.

The results of the study follow:

The average area to a farm in the entire survey is 0.955 hectare, all of which is under cultivation.

The terms of a typical tenancy contract in tobacco production are: The tenant furnishes all the labor and working capital; the landlord furnishes the land; and of the gross cash income, four-fifths goes to the tenant, and one-fifth to the landlord.

The landlord's average expense for interest on the value of his land and the tax he pays is ₱17.50 per hectare. The tenant's average total expense is ₱144.35, excluding the value of his labor and that of his family. To give a nominal value for his labor his investment costs become ₱271.76, giving him an average total cost of production per hectare of ₱311.82.

Of the ₱311.82 (cost of production to the tenant), 40.67 per cent is the cost of the tenant's and tenant's family labor, 20.20 for use of building, 12.65 for use of work animals, 6.20 for general expenses, 5.49 for use of implements, 12.89 for land rent, and 1.70 per cent for outside labor.

The average yield per hectare is 591.10 kilograms of leaf tobacco.

The purchase price of the product per hectare is ₱198.33, which is the gross income. Of this amount, the landlord gets ₱40.06 for his investment cost of ₱17.50. He therefore receives a net profit of ₱22.56 per hectare. The tenant gets a gross income of ₱158.27, giving him a labor income per hectare of ₱13.92. If the nominal value of his labor and that of his family is taken into account which is ₱127.41, he loses ₱113.49 for every hectare.

The terms of tenancy prove to be 10.46 times in favor of the landlord or 10.46 times against the tenant.

Transportation is expensive, and the *uno-con-otro* method of marketing is unsatisfactory. It costs ₱4.88 to transport a bale of tobacco from the farm to Manila, or ₱25.08 for the production of one hectare.

The buyer gets most of the profit in tobacco production; for from his total cost of ₱22,270.66 for the entire survey, he gets a return of ₱31,807.46, or a net gain of ₱9,356.80 which means a profit of 43.27 per cent.

Among the investigator's recommendations are: Increased size of farms, diversification of crops, an equitable contract between landlord and tenant, improvement of methods of culture to increase production and lower cost, better marketing by enforcing grading rules and use of co-operative associations, cheaper transportation facilities, and extension of credits to the farmers.

*Abstract by Francisco M. Sacay
Of the Department of Rural Economics*

THE GOOD FARMER IS GOOD BUSINESS MAN

"Many persons can feed a cow well, or fertilize a crop properly, but those who can run a farm successfully are in a different and much smaller class," says Dr. G. F. Warren of the state college of agriculture at Ithaca, New York.

"Successful farming consists in keeping a balance of all the factors of production in such a way as to realize the maximum profit from each," according to Dr. Warren. "A man may conduct a number of individual enterprises on his farm fairly well, but he may fall down badly on some others and thus lose out in the long run. The successful business man or farmer is dealing constantly with a large number of highly variable factors.

"Statistics show, for example, that the profits above interest on capital and farm wages for the farmer's time, on 680 dairy farms vary one hundred and seventeen times as much as does the length of men's forearms, which is a fair sample of biologic variation.

"A farmer's profits will depend on the amount of work done per man, the number of men on the farm, and the yields of individual crops. Even more complicated and variable for different farms are such items as farm receipts and farm expenses. Anyone who realizes these facts must have considerable respect for the managerial ability of a farmer who remains in business over a series of years."

—*Extension Letter* (University of Hawaii.)

THAT CROP SURPLUS: HOW CHEMISTRY IS HELPING TO SOLVE THE PROBLEM

C. MORAN

A million dollar citrus by-products industry has been established by California fruit growers the last two years, which is a striking example of how to dispose of an agricultural surplus by eating it or wearing it, or as in this case, by drinking it. These growers have decided against decreased production by converting their surplus crops into new forms of food products the demand for which has practically eliminated the surplus problem on citrus fruits.

The surplus consisted of thousands of tons of cull citrus fruits for which there was no market. Chemists took samples of the fruit into the laboratory, and after 10 years of research developed new products which are yielding profits where formerly there were losses.

A commercial method of extracting citric acid from cull lemons has been developed, and organized fruit growers have established a factory where 2 million pounds of acid is produced annually at a net profit of \$450,000.00. Forty thousand tons of waste lemons are used in the plant, whereas formerly the growers not only lost the cull fruit but had to pay \$1 a ton to dispose of it.

Waste oranges now are being manufactured into juice, marmalade, pectin, orange oil, and other products. One plant, which used 10,000 tons of waste oranges last year, produced 50,000 pounds of orange oil having a wholesale value of approximately \$100,000. Another organization prepares orange pulp into feed for dairy cows at a profit of \$2,500 a month whereas the disposal of orange pulp formerly cost \$800 a month.

A Los Angeles concern uses 60 tons of citrus fruit a day in making juice. As citrus oils are worth approximately \$2.50 a pound, the extraction and utilization of the oil means an additional return of \$12.50 for each ton of cull fruit, or, on the output of this one plant, a gross additional income of \$750 a day.

Government chemists are studying the composition of orange and lemon oils to determine the relative values of the oils for certain uses, such as the manufacture of ice creams, hard candies, cake icings, perfumes and beverages. A machine has been designed to press the oil from orange and lemon peel at the rate of 5 pounds of oil to a ton of fruit.

Chemists have produced, recently, a light-colored, well flavored sirup from pineapple juice, and methods are being developed to concentrate the juice from cores and skins to be used as a vehicle for shredded pineapple

at soda fountains. A satisfactory concentrated juice and jelly have been manufactured experimentally from pomegranates, and several concerns are adopting the method in commercial practice.

The citrus growers have solved their surplus problem with efficient, business-like methods. Waste has been eliminated by utilizing every orange and lemon grown. The walnut growers have eliminated waste by manufacturing charcoal from walnut shells. The charcoal is a high-grade product used in gas masks and other respiration devices, and sells at a profit where formerly the growers paid out real money to have the shells carted away.

Recent chemical research enables producers of other crops to help themselves. Why a corn surplus when there are more than 100 different potential industrial uses for corn? Government economists estimate that cotton consumption can be increased 2 million bales a year by developing new fabrics. Why surplus wheat when the American flax crop is insufficient for domestic needs and more than 30 different uses for flax and flax straw have been developed?

Surplus raisins are to cease being a burden in California, as a result of a process developed recently for turning raisins into a high-grade sirup. A large plant is being erected near Fresno, California, for making a sirup which is said to be one of the sweetest substances known; its color can be controlled, and it is neutral as to taste. Other raisins by-products to be made in this plant include a crude cream of tartar, a stock feed, and a fertilizer containing lime, phosphate and nitrogenous matter. The stock feed is made from raisin pulp from which the sugar has been extracted, and is to be sold largely in California. The by-products plant will employ about 150 persons.

The development of cotton bagging and sacks, and of improved cotton clothing fabrics offers a practical means of increasing the consumption of American cotton. Experiments along this line are being made in Department of Agriculture laboratories and the research laboratories of several state colleges of agriculture. It has been demonstrated that cotton bagging superior to burlap can be manufactured, and bales covered with the new type of fabric are to be shipped in international trade this year to determine how well the cotton covering stands up in actual use. Burlap is made from jute produced in India.

A list of uses of corn, including shelled corn, corn stalks, leaves and cobs ranges over 100 products from acetic acid to toilet soap. It includes axle grease, chair cushions, cigarette holders, cob sidewalks, dolls, door mats, incense, oils, paper, phonograph records, punk, shaving soap, talcum powder, telephone receivers. There is apparently no limit to the quantity of corn which may be grown profitably for utilization in the manufacture of industrial products, certainly small reason for an unmarketable surplus.

Dr. F. B. La Forge of the United States Bureau of Chemistry estimates that from 15 million to 20 million tons of corn cobs are wasted annually on

American farms. Chemists have discovered practical and probably commercial methods whereby $37\frac{1}{2}$ per cent of the corn cob substance can be converted into glucose, 30 per cent into usable mucilage, and 5 per cent into xylose, in addition to much new baking powder material and a large quantity of acetic acid, with probably other valuable by-products yet to be discovered.

Chemical laboratory work has developed cheap processes for extracting from the corn cob a synthetic resin from which telephone receivers, phonograph records, and noiseless gears can be made; furfural which has many uses in industry, including a base for varnish and mucilage; xylan, a valuable base for sulfur dyes; cellulose from which artificial silk is made, and which is used also in waterproofing, paper sizing, and cement. All these materials are obtained now from substances less plentiful and less efficient than corn cobs.

A United States patent has been obtained recently for a process which uses corn cobs in the manufacture of a lumber substitute where high tensile strength is not required. The weight of the material approximates that of light wood and may be shaped by wood-working tools the same as lumber. It may be used for making spools, picture frames, mouldings and wall board.

Similar opportunities in the use of flax seed and seed flax straw have been made possible by recent chemical research. The list of industrial products from this source ranges from artist's oil to upholstery. Utilization of seed flax straw, most of which is burned or otherwise destroyed on farms, includes rugs, fiber board, insulating material, automobile upholstery, car seats, and furniture upholstery.

Strawberry growers have learned to convert their surplus into crushed frozen fruit; surplus cranberries are being made into cranberry sauce put up in cans for the retail trade; apple sauce is being made to a limited extent from surplus crops; a limited quantity of starch is being made from potatoes—potatoes can be used to manufacture industrial alcohol; gas can be manufactured from wheat straw.

"Every part of the tree except the knot hole" is the slogan of chemists who have developed new uses from waste wood. Industry wastes little of raw materials in manufactured products. Agriculture can do likewise by utilizing all of the product of the soil, and the so-called surplus.

—Capper's Farmer (Kansas).

The word "research" is such an overworked one used, as some one has recently expressed it, "by many professors for the purpose of reducing university authorities to submission," that one hesitates to use it. But research is simply experience, experiment and fact in the process of formula-

tion. All that text-books hold and all that teachers talk about is somebody's researches in the past. But the research that we shall talk to you about as you go is the past experience lived over or amplified in work of the individual who brings it to you in a fresh and vital form. It is now an accepted truism that no one can teach inspiringly without himself having participated first hand in the evidence which he transmits. And I believe it is almost equally true that no one can investigate to the best advantage without reporting his results to others at intervals; in other words, without teaching.—FREDERICK P. GAY, from *Science*.

I didn't begin with askings, I took *my* job and stuck,
I took the chances *they* wouldn't, and now *they're* calling it luck.
And they asked me how I did it, and I gave'em the Scripture text:
"You keep your light so shining a little in front of the next."
They copied all they could follow, but they couldn't copy *my mind*.
And I left 'em sweating and stealing a year and a half behind.

—Rudyard Kipling.

EXTENSION DIVISION NOTES

Diversified Farming

Once more the problem of diversified farming is forcing itself upon the attention of the Filipino farmers. This is strongly exemplified in the case of the tobacco growers in the Cagayan Valley and the rice growers in the principal rice-growing regions of the Islands. Either crop failure or price depression thereof has caused growers to howl for more or less radical remedies, exclaiming: "Had I planted other money crops besides my lone cash crop, the old proverb about *putting all the eggs in one basket would not apply to me.*"

In our last hurried visit to Zambales in a private connection, Zambales farmers were loud in their complaints against the government delaying action on remedial measures to aid agriculture. They were seriously discussing the abandonment of rice production and replacing it with another crop. As to the Cagayan tobacco producers, in spite of sticking to a one-crop-system of farming to the point of facing famine at times they have not to any degree changed their old specialized system. From all indications it seems that the farmers have pinned their hope on emergency measures such as may be taken by the government in time of calamity or crisis, rather than on a stable remedy that they themselves can work out ahead and as a precaution against low production as well as a slump in prices.

The abandonment of a money crop already established in a locality and which has proved to be adapted to the local soil and climatic conditions and the culture and handling of which the farmers and others in the community are most familiar, is, to say the least, a risky proposition. The more so if the new crop selected to replace the old demands a specialized system of farming. In the absence of positive results from previous trials made on the farm, it would be difficult to guarantee a profitable yield and money income as outcome of the new crop. Hence, the farmer is reduced to the rôle of an experimenter rather than a commercial producer, and he must be prepared to take the consequences of the risk involved in running an experiment.

Experimental plantings should be undertaken by the government through its experiment stations. This, however, does not prevent a farmer or a group of farmers from carrying out their own experimental plans. The Hawaii Experiment Station under the direction and financing of the Federal Department of Agriculture is mainly engaged in diversifying Hawaiian cane farming, while the Hawaiian Cane Sugar Association is conducting its own experiments on sugar cane for the sugar cane planters through its own private experiment station.

It seems then that the wisest thing for the farmer to do under such circumstances is to stick to his old crop and improve it in the direction of increasing its yield by proper tillage, timely planting of the crop, use of good seed, rational fertilization, reduction of cost of production and holding the product for a reasonable length of time for a better market price. He should plan for a cropping system better suited to his particular farm if he finds the change advisable with the character of his farm from points of climate, lay and extent of land, kind of soil, and available capital and labor. Then he could gradually evolve a general or diversified system of farming for his farm, bearing in mind the following:

1. That "special farming is the growing of a single crop or at most the growing of one main crop with one or two minor crops."

2. That diversified or mixed farming or general farming "is the growing of several crops of approximately equal importance, and usually includes the keeping of one or more kinds of live stock."

3. That each of the two systems of farming have its advantages and disadvantages, although the diversified system is always cited as being more advantageous than the specialized system for various reasons, of which the two most outstanding and fundamental are: (a) "fertility more easily maintained, (b) better distribution of labor as well as diversity of interest."

The choice, however, of a system of farming largely depends upon many things: "personal likes and dislikes, adaptation of the land and climate; plan of rotation desired; markets to be supplied and labor to be employed."

Example of Diversified Farming

Every year the students taking the course in Coffee (Agronomy 11) in the College of Agriculture are required to make a trip to a barrio Mataas-na-kahoy in Lipa, Batangas. This barrio is widely known for its superior quality of coffee and for its beautiful orchards. Horticulturists from government bureaus and farmers from different regions often visit the place to see its beautiful plantations. The students go there to see coffee plantations being developed on a commercial scale and to hear the experiences of old planters in coffee culture. Many planters in this barrio can speak with authority from actual field experience in coffee culture, as their experience dates back to the time of the famous coffee period in Lipa.

Besides the coffee plantations the students can see an example of diversified farming practiced in a very ingenious way. The practice of diversified farming with annual crops and live stock is quite common. But this case is a diversification of permanent and semi-permanent crops in partial combination with the husbanding of some live stock, such as horses, hogs, and poultry. Coffee and coconuts are the most common combination and in the coconut plantations various other crops are raised in great quantities. Lanzons, not inferior in quality to the Laguna lanzon, supposed to be the best kind in the Islands, are grown, also bananas in large quantities. Also

various other plants as cacao, citrus, chicos, pineapples, kapok, black pepper, etc., are grown. In many cases all these crops are raised with coconut in one lot, so that almost every bit of the ground is planted with something. It is very hard to find in the Islands a locality with an equal degree of diversification. Many of the lots are so full of plants that one might consider them "over-planted" if there is such a word. Of course this practice may be considered unsound from the standpoint of horticulture, but after knowing the conditions obtaining in this barrio, one will be convinced that these farmers are justified in their practice.

There are conditions existing in this progressive barrio which are not very common in other Philippine barrios. It is one of the few barrios in the province of Batangas in which there are very few tenants. The *kasama* system of land tenure is hardly known. The land is very evenly distributed among the people—a condition not common in the old established Philippine communities. Almost every one is sole owner of a piece of land ranging from one-half hectare to about 10 hectares. The most common area possessed by a family is from 2 to 5 hectares, few own more than 30. A hundred-hectare *hacienda* is not to be found. With such even distribution of land every one has an incentive to cultivate his land to its full yielding capacity, because every one has to depend upon his own soil for his subsistence. He has no landlord from whom to get money. He cannot borrow from others unless he mortgages a part of his land; this he cannot afford to do. With the object of getting the most out of his land he plants all kinds of crops that can be grown in the community. This condition of land-owning explains the existence of the diversified farming in Mataas-na-kahoy.

The farmers follow a common procedure, first planting the lot with coconuts. For the first two years rice and corn are raised in the planted lot. Since the coconut does not bear in commercial quantities until after 10 or 12 years, they plant crops that bring quick income, as papayas, bananas, pineapple, coffee, etc. In this way they get something for their support while waiting for the coconut crop. As the coconuts grow, plantations become more and more crowded. By the time the coconuts are bearing, the land in the coconut grove is covered with plants. The farmers do not dare cut out these plants for they know that income from coconut comes only every three months. So in order to have a steady income all the year round they keep these plants. As a matter of fact, the farmers usually plant fruit trees, such as chicos and lanzons which are known to live longer than coconuts.

It is a question whether these farmers would not get more returns by growing only one kind of crop than by the practice they follow. No one questions that the full yielding capacity of one crop is affected because of too much crowding. But no figures have yet been obtained as to which practice would give the most income. But one thing is certain and that is

their incomes are surer by having many crops than by having only one crop. Since they are self-dependent they cannot afford to run the risk of missing their "bread," so they choose the safer course.

This diversified farming by the farmers of Mataas-na-kahoy has hindered the development of a specialized crop, as coffee, into a thriving industry. But they have shown that diversification may solve financial problems of Filipino farmers, where local conditions lend themselves to diversified farming at a profit ultimately greater than can be secured from specialized farming.

Our Most Popular Campus Attraction

The College of Agriculture is now one of the most if not the most popular places for excursionists in the Islands. People from all walks of life, especially students from different educational institutions in Manila and the neighboring provinces, come to the College Campus for a day off. It seems that there is something in the College worth the visit. It may be interesting to know what places in the College are the most attractive. As taste and appreciation vary with individuals, choice as to our attractive spots will vary. There may be some who may like best the beauty of the College environs. There may be others who are serious minded enough to realize the significance of our experimental ground and scientific laboratories where search for truth for the improvement of Philippine agriculture is carried on. And there may be still some who are more impressed by the panorama of the College Campus as a whole. But undoubtedly the great majority of those with a degree of aesthetic sense who visit the College will unanimously declare that the College ornamental nursery is the most attractive spot on the whole College Campus. Indeed, a good number of excursionists who come care to see only the ornamental nursery and fail to visit the other instructive places of the College. We often fear that they may have the idea that the College can produce only something that pleases the eye.

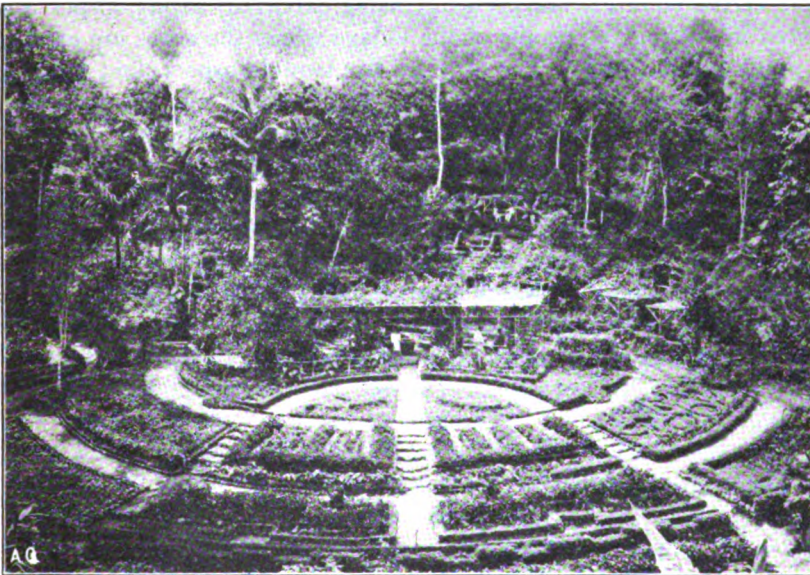
We can easily say that the nursery of ornamentals though scarcely half a hectare in area is the best known spot on our 300 hectares of the College ground including the experiment station. It is the spot most frequented and best remembered by all College visitors. One instance may be cited to indicate the impression that it makes on our visitors.

One time a prominent University professor, after having been shown all that the College usually shows our visitors, expressed his impressions of the College Campus. He made a speech before a crowd, in which he made the College ornamental nursery his central topic. The thing that impressed him the most is that out of inexpensive local ornamentals, instead of imported materials, the elaboration of the ornamental nursery has been ingeniously effected. "It is remarkable," he said, "that men could make a combination of nature's simple resources and produce so highly pleasing

an effect. It is true that there are many beautiful flower gardens in Manila and other places, but in those places a considerable amount of money has been spent for imported materials and such artificial structures as glass houses, elaborate sheds, and trellises, and cement outlines. Such things do not impress one so much as when such beautiful things are made with simple things of nature at an expense within the reach of modest human effort."

In his speech the College professor unconsciously voiced the opinions of thousands who have been similarly impressed by the College ornamental nursery for which Mr. Vicente Dawis, instructor in Agronomy, and his class and assistants in landscape gardening are largely responsible.

The text figure bears out the Manila professor in his commendatory remarks.



While this feature of the College course of study may appear unimportant in the broad scheme of productive agriculture taught by the College, flower and landscape gardening is one of the most productive forms of agriculture where the demand for flowers and landscape gardening skill, as in Manila and other large cities, is great. Flower gardens in Manila, particularly those run on a scientific basis, have been found to be highly profitable. It constitutes a valuable asset for a farmer who actually does his own farming, whether in a small or large *hacienda*, to break the monotony and drudgery of a country life—inducing the farmer to live on his farm and shun cockpits and other vices often resorted to in days of lay-off on the farm.

Most people define agriculture as an occupation. Modern agriculture is more than that, says Dr. C. C. Taylor, of North Carolina. Farmers raise poultry, for example, not just for the sake of raising poultry, but for food and shelter and luxuries. So agriculture is more than an occupation: *it is a level of life*. And the standard of living is measured in terms of *food, clothes, shelter, health, education, religion, recreation, and social contact*. The task of the agricultural leader, then, is not only to help farm people obtain dividends, but to help convert these dividends into a satisfying life.

—*Extension Letter* (University of Hawaii).

"Of the total cultivated area of British India, about 84 per cent. is devoted to food crops, about 75 per cent. is devoted to food crops for the people of the country, ten per cent. being exported; about 60 per cent. is devoted to feeding the people of the village where the crops are grown, the rest going to the towns. The problem has twofold aspect: first to grow the food of the people on a smaller area so as to release a larger area whereon to grow money crops, and secondly to discover such food crops as the people will consume and as will respond to intensive cultivation, so that the family may be more fully occupied on the tiny holding with profit to themselves. In brief, it is extremely important to devise a scheme whereby the cultivators will be able to use their present leisure in the profitable cultivation of their holdings. It is doubtful whether any scheme could be evolved to occupy all the present leisure, so that the need for subsidiary industries will remain, but this is outside the scope of the present paper."

EXCHANGE NOTES

Lack of uniformity is the great fault with bacon. This is largely due to multiplicity of breeds which vary in type, and are mostly not suitable for the production of a high class product. The bacon type is that which produces the bulk of the meat in the most valuable parts, and the least weight in those parts which are of lower quality and value. In short, nearly all the meat behind the girth or shoulder is worth about twice as much as that in front of the girth. Some breeds are noted for a great crest on the neck, heavy shoulder and jowl, the production of which represents a waste of good food. Others have light neck, shoulders, and jowl, are narrow at the wither, getting heavy towards the hindquarters, and have a long side, thick flank, and full thigh. This is the bacon type. How are we to produce it?

—*Journal of Agriculture* (Victoria, Australia).

Next year you will be celebrating a very interesting anniversary because it was in the year 1878 that Sir Henry Wickham brought those famous seeds from the Amazon to Kew.

Those together with Gold Coast cocoa form two of the most amazing romances of science and industry. Fifty years ago those seeds were brought to Kew and germinated under glass there, and carried out first to Ceylon and then on to Malaya, and from these has sprung the gigantic industry the toast to which it is my privilege to propose. The Gold Coast industry developed much on the same lines. They had not heard of cocoa there but a chance individual brought a cocoa bean to the mainland and planted it, with the result that last year just over half the world's supply was produced by one British possession overseas. Those are the romances of tropical agriculture. There is therefore no reason why that should not be done in other cases.

—*The Planter* (F. M. S.).

Most farmers think it's a good idea to feed their hogs salt, but they don't all know how much to feed. A heaping teaspoonful of salt to a pound of grain is about right. Of course, the quantity to feed depends on the size of the pigs and on whether the animals have been getting salt regularly. If you hold back the salt for some time—then feed it in large quantities, it may cause trouble, even death. The hogs should get small amounts of salt as a regular thing in the ration.

—*American Swineherd* (Chicago, Illinois).

At the present time eleven-twelfths of the value of the agricultural products of Queensland are marketed through a co-operative system under the control of the producers themselves. It has been estimated that during the financial year that has just closed the value to the agriculturists of Queensland in the increased returns as a result of co-operatively controlled marketing exceeded £1,000,000 sterling.

—*Agricultural Journal* (Queensland).

As everyone knows, the avocado, or alligator pear—the poor man's butter—is grown everywhere throughout Jamaica up to say about 3,000 feet, no one however has ever selected varieties and we have scores of different types. There are also varieties we have read of in Guatemala and Mexico which grow up to 5,000 feet and which would be very suitable for the mountains here. In fact they do not seem to flourish in the lowlands in these countries. Varieties from these parts have been introduced into Florida and Southern California and have been tested. Out of the varieties very few have been found to suit conditions and they had to be selected. This selection of course took a period of years. The trees, however, can be budded so that poorer varieties can be made to bear selected varieties. It would be exceedingly useful if we could pick out good types here and only grow these.

The writer shipped pears to the British Empire Exhibition successfully, but it took a great deal of selection to find varieties that would keep and yet were good for the table.

There are here, round varieties and bottle-neck varieties, shiny green varieties, and red and purple varieties; the red and purple varieties should be done away with, although these are just the kinds that grow best in the high hills.

—*Journal Agricultural Society* (Jamaica).

"Australian tobacco interests are concerned about tobacco-aroma," reports Mr. T. H. Patterson, Fields Division. "American leaf is the standard for the world. Is aroma due to soil or climate, or do both combine to produce aroma? These are the questions awaiting answers. Sufficient soil was brought from North Carolina, where it is considered the best leaf is grown, to lay down two plots—one fertilized, the other not. Side by side are two plots of Australian soil taken from Bathurst Experimental Farm, where the trials are being conducted, one being fertilized and the other not. The soil is set on concrete, with concrete divisions, to prevent seepage from the soil outside from plot to plot. The cost of bringing the soil was about £200. The Australian leaf aroma is different from that of American, and the smoker looks for the latter, as he is accustomed to it."

—*Journal of Agriculture* (New Zealand).

COLLEGE AND ALUMNI NOTES

The appointment of José S. Camus, B. Agr., '14, as Assistant Director of the Bureau of Agriculture was confirmed by the Senate in its executive meeting of November 8, 1927.

The *Committee Reports for the Fifth Annual Convention* of the Philippine Sugar Association, held in Manila September 12-17, 1927, lists among the contributors Dr. Manuel L. Roxas, Dr. G. O. Ocfemia, Dr. Leopoldo B. Uichanco, and Mr. Francisco Sacay of the College faculty; and Mr. F. Q. Otones, Mr. Mariano G. Medalla, Mr. Segundo D. Labayen, and Mr. Benjamin Hollero from the College Alumni.

Doctor Roxas, as chairman of the Committee on "Cane Varieties, Diseases and Fertilizers," submitted a report covering ninety-eight pages of the printed proceedings.

On Sunday evening October 30, 1927, by invitation, Rev. Hugh Bousman, Student Pastor, Student Union Church, presented in the College Auditorium a play, "The Runaway Slave". This short drama, written by Mr. and Mrs. Bousman, is based on the Apostle Paul's letter to Philemon.

The characters in order of their appearance were:

Roman soldiers.....	Thomas Tate
	Esteban Sadang
Timothy.....	Domingo Tugade
Paul, A Roman Prisoner.....	Charlebois Case
Onesimus, A Runaway Slave.....	Luis Segovia
Philemon, Master of Onesimus.....	Celestino Razón
Archippus, Philemon's son.....	Honorio Ylizarde
Apphia, Philemon's wife.....	Ernesto Lopez
Jason and Lucius, slaves.....	Thomas Tate
	Esteban Sadang

The first scene was in Paul's prison cell.

The second in Philemon's home.

Much care had been taken in costuming the play and in giving the proper scenic and lighting effects. To students who saw the play, Paul will be a more real individual than before; Philemon, his friend, a very human man. Not soon will they forget the colorful costumes, the dramatic lines and action by which this bit of the past in the day of Rome's far-reaching power was made real.

The community "sings" that were held in 1923-25 under the leadership of Professor E. Gertrude Madison, of the Department of English have been revived this year with Mrs. Hugh Bousman as the leader and with Professor Roa as the accompanist.

Both faculty members and students attend the "sings" which are held on Monday evenings in the Auditorium.

The U. P. Soccer Football Championship for 1927-1928 was definitely decided on November 6, when the invading U. P. Manila team won a hard fought game from the U. P. Los Baños aggregation on the latter's home grounds. The score was 3 to 2. The U. P. Manila team won the first game of the series which was held in Manila on October 30 by the close score of 1 to 0.

As an official University Championship athletic event between the U. P. Manila and Los Baños Units, Soccer Football was adopted in 1925-1926. The Los Baños Colleges' team copped the championship for that year: the Manila team won that of 1926-1928.

Following are the completed events in the 1927-1928 U. P. Los Baños Athletic League, showing the final standings of the competing teams:

BASKETBALL

C. A. Seniors.....	60	Points (Pennant Winner)
C. A. Sophomores.....	50	"
C. A. Freshmen.....	40	"
C. A. Juniors.....	20	"
Veterinary.....	20	"
C. A. Preparatory.....	20	"
Forestry.....	0	"

VOLLEYBALL

C. A. Preparatory.....	60	Points (Pennant Winner)
C. A. Sophomores.....	40	"
C. A. Freshmen.....	35	"
C. A. Juniors.....	25	"
Veterinary.....	20	"
C. A. Seniors.....	15	"
Forestry.....	15	"

RELAY CARNIVAL

C. A. Seniors.....	32	Points (Pennant Winner)
C. A. Freshmen.....	20	"
C. A. Preparatory.....	20	"
C. A. Sophomores.....	12	"
C. A. Juniors.....	6	"
Forestry.....	0	"
Veterinary.....	0	"

THE NATION AND SCIENCE

BY HERBERT HOOVER

(Extract from article in *Sigma Xi Quarterly*, March, 1927)

And the more one observes the more clearly does he see that it is in the soil of pure science that are found the origins of all our modern industry and commerce. In fact, our civilization and our large populations are wholly built upon our scientific discoveries. It is the increased productivity of man which has come from these discoveries that has defeated the prophesies of Malthus. He held that increasing population would constantly lower the standard of living amongst men until the pressure of subsistence upon population would limit its number by starvation. But since his day we have seen the paradox of the growth of population far beyond anything of which he ever dreamed, coupled with a constantly increasing standard of living. This result would be impossible but for the men of fundamental scientific research and discovery. In fact, there is for the future but one contestment in the race with the principle of Malthus, and that is in pure science. If we would have our country increase in its standards of living and at the same time accommodate itself to an increasing population at the rate of more than 15 millions each decade we must maintain the output of our pure science laboratories.

The wealth of the country has multiplied far faster than the funds we have given for these purposes. And the funds administered in the nation today for it are but a triviality compared to the vast resources that a single discovery places in our hands. We spend more on cosmetics than we do upon safeguarding this mainspring of our future progress.

Eighty per cent of the men devoted to pure science research with us are in our scores of universities and colleges. Our universities have doubled in the number of their students. Their pre-war endowments and income have been depreciated by the falling dollar. New resources have been given many of them, but not enough to handle their new burdens of teaching. All of this has led them to more and more curtailment and the suppression of expansion in pure science research in order that they might attend the immediate problem of education. Thus the four or five thousand men in the United States who had demonstrated their ability for research of this character are not applying themselves in this direction so much as they are applying themselves to the education of the youth. Teaching is a noble occupation but other men can teach and few men have that quality of mind which can successfully explore the unknown in nature.

Not only are our universities compelled to curtail the resources they should contribute in men and equipment for this patient groping for the sources of fundamental truth because of our educational pressures, but the sudden growth of industrial laboratories themselves and the larger salaries they offer have in themselves endangered pure science by drafting men from the universities. This is no complaint against our great industries and their fine vision of the application of science. It simply means we must strengthen the first line of industrial advancement—pure science research.

These men of pure science are the most precious assets of our country and their diversion to teaching and applied science reduces the productivity which they could and should give to the nation. It is no fault of their own, but it is the fault of the nation that it does not give to them and to the institutions where they labor a sufficient support.

There is no price that the world could not afford to pay these men who have the originality of mind to carry scientific thought in steps or in strides. They wish no price. They need but opportunity to live and to work. No one can estimate the value to the world of an investigator like Faraday or Pasteur or Millikan. The assets of our whole banking community today do not total the values which these men have added to the world's wealth.

Some scientific discoveries and inventions have in the past been the result of the genius struggling in poverty. But poverty does not clarify thought, nor furnish laboratory equipment. Discovery was easier when the continent was new. Discovery nowadays must be builded upon a vast background of scientific knowledge, of liberal equipment. It is stifled where there is lack of staff to do the routine and where valuable time must be devoted to tending the baby or peeling potatoes, or teaching your and my boys. The greatest discoveries of today and of the future will be the product of organized research free from the calamity of such distraction.

The day of the genius in the garret has passed, if it ever existed. The advance of science today is by the process of accretion. A host of men, great equipment, long patient scientific experiment to build up the structure of knowledge, not stone by stone but grain by grain, is now our only sure road of discovery and invention. We do have the genius in science; he is the most precious of all our citizens. We cannot invent him; we can, however, give him a chance to serve.

He that questioneth much shall learn much.

—BACON.

THE ANTI-BERIBERI VITAMIN CONTENT OF SWEET POTATO LEAVES AND SHOOTS¹

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WITH TWO PLATES

In 1922 the senior author found that sweet potato (*Ipomoea batatas*) shoots and leaves form an excellent source of vitamin B for rats. Albino rats which had been decreasing in weight owing to lack of vitamin B, on being given daily one gram of air-dried shoots and leaves of sweet potato, rapidly recovered and increased in weight. At present, as control source of vitamin B, we are using in our laboratory dry sweet potato leaves and shoots, instead of the expensive yeast vitamin. We find that one-half gram of this material given daily as supplement to an otherwise complete ration enables rats to grow normally.

In 1922 Sherman and Smith defined vitamin B as follows:

The term vitamin B at present includes: (1) the antineuritic vitamin found by Eijkman in rice, Grijns in beans, Funk and others in yeast, and later found in a wide variety of animal and vegetable substances, the absence of which causes polyneuritis in fowls, beriberi in man and a similar pathological condition in other mammals; (2) a water-soluble growth-promoting substance found by Hopkins, Osborne and Mendel, and McCollum in milk and later found in wheat embryo, yeast and the various materials furnishing the antineuritic vitamin. Absence of this vitamin causes loss of appetite, cessation of growth and finally pathological symptoms resembling those of beriberi. Similarity in occurrence and many properties speak for the identity of the anti-neuritic and growth-promoting water-soluble vitamins.

A study of the published work on vitamin B, however, shows that the growth-promoting water-soluble and the antineuritic factor are not identical.

Pacini and Russel (1918) and Bierry (1919) found that various bacterial cultures contain water-soluble B. Eijkman, *et al* (1922) did not succeed in confirming these experiments in regard to the antineuritic factor.

Nelson, Fulmer, and Cessna (1921) cultivated baker's yeast in an artificial solution of NH_4Cl , CaCl_2 , K_2HPO_4 , CaCO_3 and cane sugar. This yeast when added to an otherwise complete ration (2 per cent), except for vitamin B, enabled white rats to recover in weight and to grow.

Eijkman, van Hoogenhuyze, and Derks (1922) cultivated yeast in a synthetic medium (NaCl , KH_2PO_4 , CaSO_4 , MgSO_4 , FeSO_4 , MnCl_2 , ZnCl_2 , NH_4Cl , dextrose + H_2O). This yeast did not prove effective in curing polyneuritic fowls.

¹Experiment Station contribution No. 506. Read before the Los Baños Biological Club March 3, 1927. Received for publication October 15, 1927.

Levene and Muhlfeld (1923) tested three samples of baker's yeast (Nos. 2, 3, and 9) and one sample of brewer's yeast. In daily doses of 0.200 gram, all the samples enabled white rats to grow normally. In 0.100 gram doses, brewer's yeast and baker's yeast No. 3 were sufficient to maintain normal growth, whereas Nos. 2 and 9 in such doses gave less satisfactory results. Thus, the proportional difference between the best and the poorest samples was not greater than 2 to 1.

With pigeons they obtained the following results:

Brewer's yeast protected pigeons from polyneuritis in doses of 0.500 gm. per day; baker's yeast No. 3 gave irregular results in doses of 0.200 gm. per day and protected completely in doses of 0.500 gm. per day. Baker's yeast No. 9 failed to protect in doses of 0.500 gm. and gave irregular results in doses of 1.0 gm. (of three pigeons, one lived 50 days and two remained in perfectly normal condition after 70 days). Baker's yeast No. 2 failed to protect pigeons from polyneuritis in doses at least four times as large as the protective dose of No. 3.

Hauge and Carrick (1926) using chicks as experimental animals found that yeast is poor in antineuritic substance but rich in the water-soluble growth-promoting substance; and that corn is relatively rich in the antineuritic substance, but poor in the growth-promoting substance.

In testing for the presence of vitamin B, two types of animals have been used—the rats and fowls. The effect on the weight of the rats and the development of polyneuritis in the fowls has been generally taken as the criterion for judging whether the food tested is poor or rich in vitamin B. Hence, generally speaking, the test for vitamin B in which rats are used as the experimental animals should be interpreted as test for the water-soluble growth-promoting factor, and the test in which fowls are used, as test for the antineuritic vitamin. As shown above, food rich in growth-promoting substance is not necessarily rich in the antineuritic factor.

Regarding the identity or non-identity of polyneuritis gallinarum and beriberi, Vedder and Clark (1912) may be quoted:

It is apparent from this study that the symptomatology and pathology of polyneuritis gallinarum can not be regarded as identical with that of beriberi in man. We have never observed any oedema in fowls at all comparable to wet beriberi in man, and while there are undoubtedly slight changes in the heart of fowls suffering from polyneuritis, there is none of the hypertrophy which is such a characteristic finding in human beriberi. In spite of these facts, however, there is more similarity than difference between the two diseases.

When we consider the etiology of the two diseases, the case is different. The experiments of Fraser and Stanton and of Strong and Crowell prove beyond the shadow of a doubt that beriberi in man is the result of a too nearly exclusive diet of polished rice, or of other foods lacking in the neuritis-preventing substance. It has been proved beyond question that polyneuritis of fowls is due to a similar diet. The cause of the two diseases is therefore the same. Therefore, the conclusion already published by Chamberlain and Vedder "that the two conditions are due to the same pathological process causing slightly different manifestations in diverse species" is abundantly justified. Since this is the case, it is evident that we may deduce some important facts concerning the relation between diet and beriberi from the above feeding experiments on fowls.

Shimazono (1925), a Japanese authority on the same subject, may also be quoted:

Years ago I said that beriberi and polished rice disease are in a state of very close resemblance; I do not now hesitate to say with the foregoing observations on avitaminosis, that beriberi and vitamin B deficient disease are in a state of very close resemblance. This view has more weight, when one sees human avitaminosis. If we examined our cases of human avitaminosis at a clinic as outpatients, we should not hesitate to diagnose them as beriberi. But in comparison with the ordinary beriberi, anorexia is marked, and changes in circulatory organs are comparatively little.

Thus the symptoms and pathological findings of beriberi and vitamin B deficient disease hitherto observed are not quite the same. The relation resembles that between Grave's disease and experimental hyperthyroidism, as is well known we find some differences between Grave's disease and experimental hyperthyroidism although they are in close resemblance. Experimental avitaminosis may be produced equally well in any season, while beriberi has marked seasonal differences. It is more prevalent in a warm than in a cold season. It is beyond doubt that the deficiency of vitamin B in diet has an important relation with the onset of beriberi. It requires further investigation as to whether or not other conditions are necessary for onset of beriberi. We do not attain yet to the conclusion held by many scientists abroad and Ohmori and others in Japan that beriberi is avitaminosis and that the two are one and the same. On the other hand, we can not exactly agree with McCarrison, Ogata, and others who believe that onset of beriberi requires some other causation besides lack of vitamin B. This point requires further study.

We, however, recognize that diet insufficient in vitamin B induces disposition for beriberi or rather it is the principal cause of the development of beriberi and when polished rice forms the staple, with addition of even a considerable amount of animal and vegetable foods, such diet may have insufficiency of vitamin B. Consequently we recommend the avoidance of polished rice diet and the taking of half polished rice or mixture of rice and barley in equal amount.

The test for vitamin B in sweet potato reported by Santos in 1922 is essentially a test for the growth-promoting water-soluble B. Hence, the necessity for testing the antineuritic or antiberiberic factor.

EXPERIMENTAL

Materials

Seventeen cockerels were used in the experiment, six of which were furnished by the Poultry Division of the Department of Animal Husbandry, and eleven were taken from the flock belonging to Molawin Hall (Students' Mess.)

The feeds were washed polished rice, washed casein, salt mixture². Gravel, charcoal, and filter paper were also offered to the birds. They had access to water at all times.

The birds were confined in wire cages, 90 cm.×90 cm.×80 cm. in size. These cages were so placed that they were exposed to some sunshine,

² The salt mixture prepared according to McCollum and Davis (1915) had the following composition:

Sodium chloride.....	5.00 gm.
Dipotassium phosphate.....	12.10 gm.
Primary calcium phosphate monohydrate....	2.56 gm.
Calcium lactate.....	29.44 gm.
Iron citrate.....	1.00

either in the morning or afternoon. The floor of each cage was cleaned every day.

Methods

The technique followed was essentially as follows: The animals were given a diet known to be deficient in antineuritic vitamin. As soon as clear external symptoms of polyneuritis were observed, camote was given daily in addition to the basal food. The external symptoms noted in most of the animals were: leg weakness, ruffled feathers, bluish comb, peculiar gait, tendency to raise feet in the air, or high stepping gait, stumbling, then unable to sit up, lying upon its side, *then becomes prostrated*. Also wing drop, retractions of the head, unable to swallow normally, slow but deep respiration, loss of weight.

Studies of the nerves of the birds that showed external symptoms and died uncured showed degeneration. The autopsies were performed by Dr. A. K. Gomez of the Department of Bacteriology and Pathology of the College of Veterinary Science.

The basal diet consisted of washed polished rice. Casein and salt mixture were given to the animals some time during the progress of the experiments. Vedder (1912) showed that polyneuritis gallinarum results with an otherwise balanced diet provided said diet is deficient in antineuritic principle. Our results are in harmony with this observation.

Results

Owing to lack of facilities, we were not able to place all the birds under experiment at the same time. Cockerels No. 5, 7, 8, 13, 14 and 15 died from unknown cause before we could see signs of polyneuritis, hence were not treated with camote.

Cockerel No. 16 did not look healthy from the beginning and died the day it was given sweet potato leaves and shoots. These seven fowls were of no use for the test for the antineuritic property of camote. Results on fowls treated with sweet potato follow:

Cockerel No. 1 weighed 699 grams on May 15, 1926, when it was placed on polished rice diet. The weight gradually increased to 790 grams by June 5. From this date the bird gradually decreased in weight. By July 10 its weight was only 561 grams and it showed clear symptoms of polyneuritis. From July 12, 5 grams fresh sweet potato leaves and shoots were administered daily. On the improved diet, the fowl became livelier and the polyneuritic symptoms disappeared, but its weight did not materially increase. From August 17, one gram casein was also given daily. Still, there was no material improvement in weight. So from September 14 salt mixture (0.1 per cent of the weight of the rice) was added. From this time the weight increased rapidly. By October 30 the animal weighed 1055 grams. From this date sweet potato was eliminated and the animal subsisted on polished rice, casein, salt mixture, gravel and charcoal, and

filter paper. On this diet the cockerel gradually lost weight and developed polyneuritis. On December 7, it was unable to stand. Again, sweet potato was given. On December 11, the bird was lying on one side, and was unable to swallow food. An injection of camote extract was given. On the morning of December 14, the animal was found dead. Autopsy showed that the bird was suffering from other ailments besides polyneuritis.

Cockerel No. 2. This animal weighed 715 grams on May 15, 1926, when it was placed on a diet of polished rice. The weight first increased and then gradually decreased. On July 24 it weighed 610 grams and five days later showed marked symptoms of polyneuritis (fig. 1, pl. I). As it was unable to swallow food, extract corresponding to 5 grams of fresh sweet potato leaves and shoots was given by mouth with a pipette. The second day, July 31, the animal was in a worse condition, (fig. 2, pl. I), being unable to move and lying flat on one side, though still alive. We thought that it would die. Ten grams fresh sweet potato was forced into its mouth. The poor bird swallowed this ration with great difficulty. Another day passed and the bird was still alive. August 3 found the bird in the same dying condition. At about 11:00 a. m. of this day, 2 cc. of sweet potato extract corresponding to 10 grams of fresh sample was given by intramuscular injection and then 5 grams of fresh sweet potato was given by mouth. After this treatment was given, the senior author gave instructions that the animal was to be watched and as soon as it died it was to be placed in the ice box for autopsy the next morning. The next morning, however, the bird was found moving about able to pick up and eat rice. The administration of fresh sweet potato leaves, 5 grams daily, was continued. Three days later (August 6) (fig. 3, pl. II) the bird was able to stand and from August 9 it was able to walk normally. By August 17 the animal looked perfectly normal except that the weight had not increased. So from this day 2 grams casein were given daily in addition to sweet potato and polished rice. From September 14 the feed was further strengthened with salt mixture. On October 30 the weight had increased to 1045 grams, and the animal looked ready for the cockpit (fig. 4, pl. II). Then the administration of sweet potato was stopped and the cock made to subsist on a ration of rice, casein, and salt mixture—a diet that is deficient in antineuritic vitamin.

After 27 days on this deficient diet, the fowl's legs were observed to be weak and the animal was in kneeling position much of the time. So five grams of sweet potato were again administered daily. On November 30 the animal was found dead. Autopsy showed that it had pneumonia.

Cockerel No. 3. This bird weighed 955 grams on May 15, 1926, when it was placed on a diet of polished rice. Like Nos. 1 and 2, it first increased in weight and then decreased.

By August 4 the symptoms of polyneuritis were very marked, so the daily administration of 5 grams of fresh sweet potato was begun. Improvement in the appearance and movements of the animal soon followed, but

still there was little increase in weight. From September 14, salt mixture was added to the diet. By October 30 the weight had reached 1172 grams and no sign of polyneuritis was detected. The fowl's desire to fight was very apparent. From October 30, sweet potato was again excluded from the diet, leaving only polished rice and salt mixture. By November 23, leg weakness and change in the color of the comb were again observed. Three days later the symptoms of polyneuritis were very marked. The neck was stiff and the animal could not stand. So again, 5 grams fresh sweet potato were given daily. The day after the first sweet potato ration the bird was "talking", as if it were thanking us for the life-giving sweet potato. On the second day it was able to move about the cage; and on the third it was able to pick up its own food. On January 17, again sweet potato was withdrawn. On February 4 the bird's gait was noticed to be unsteady; and the next morning the animal could not stand. So sweet potato was again given. In the afternoon of the same day, the bird was crowing. From February 18 to the end of the experiment it ate alone.

Cockerel No. 4. This bird weighed 937 grams on May 15, when it was placed on polished rice diet. This bird first increased and then decreased in weight. By August 4 it was clearly down with polyneuritis; so the addition of 5 grams fresh sweet potato leaves and shoots daily was begun. At once, the animal began to improve in appearance; but the weight did not materially increase. From September 14, salt mixture was incorporated with the diet, and the weight gradually increased, until by December 7 the bird weighed 1012 grams and the animal looked very healthy. From this date, sweet potato was cut off, and for the second time the fowl was placed on an antineuritic deficient diet of polished rice and salt mixture. On January 25, 1927, the animal's legs seemed weak. Four days later, the gait was unsteady, and the feathers looked rough. Then, again, five grams of sweet potato were given daily. By February 12, great improvement in the physical condition of the animal had taken place. The legs appeared normal by March 5. On June 4 the weight was found to be 1393 grams and the bird was as healthy as the cocks in the cockpit.

Cockerel No. 6. This bird was placed on polished rice diet August 4, 1926. By August 31 it had polyneuritis. It was then given, by mouth, 2 cc. of uray extract (*Amaranthus viridis*) which corresponds to 10 grams of fresh uray shoots. On September 3, the bird was lying flat on one side and looked as though it were dying. So the uray extract was replaced with fresh sweet potato leaves and shoots. Four days later, the bird was very much improved in general condition though there was little change in weight. So from September 14 salt mixture was incorporated with the diet. By December 10 the weight had gradually increased and the animal appeared as healthy as ever. From this date sweet potato was withdrawn, leaving only polished rice and salt mixture. By February 8 the bird was again down with polyneuritis, so again, sweet potato was given as sup-



Fig. 1.—Cockerel No. 2, on July 29, 1926.

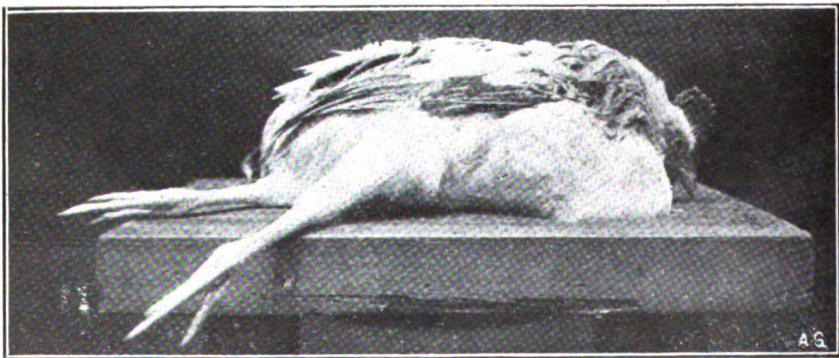


Fig. 2.—Cockerel No. 2, on July 31, 1926.

(Photographs by the Photographic Division, College of Agriculture)

PLATE I

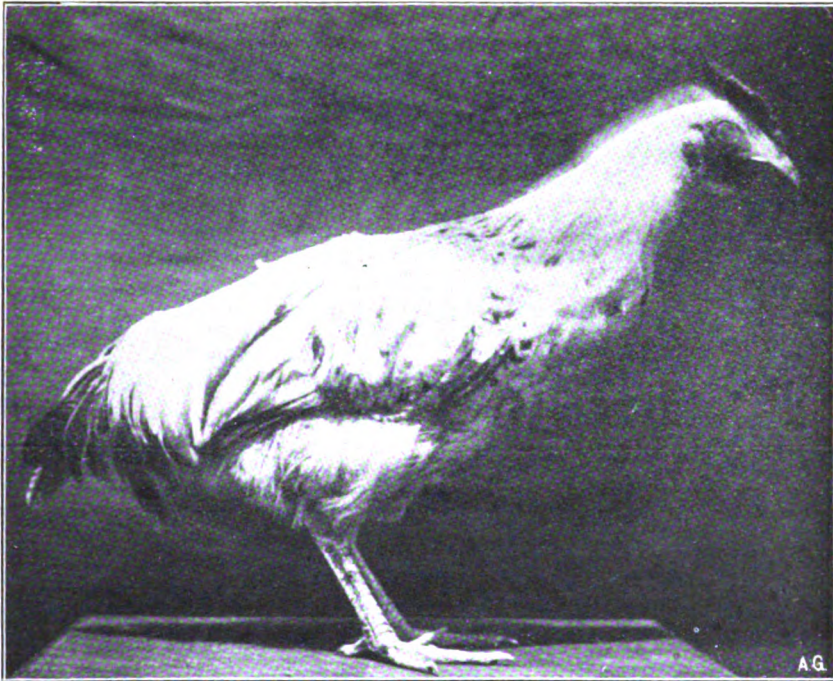


Fig. 3.—Cockerel No. 2, on August 6, 1926.

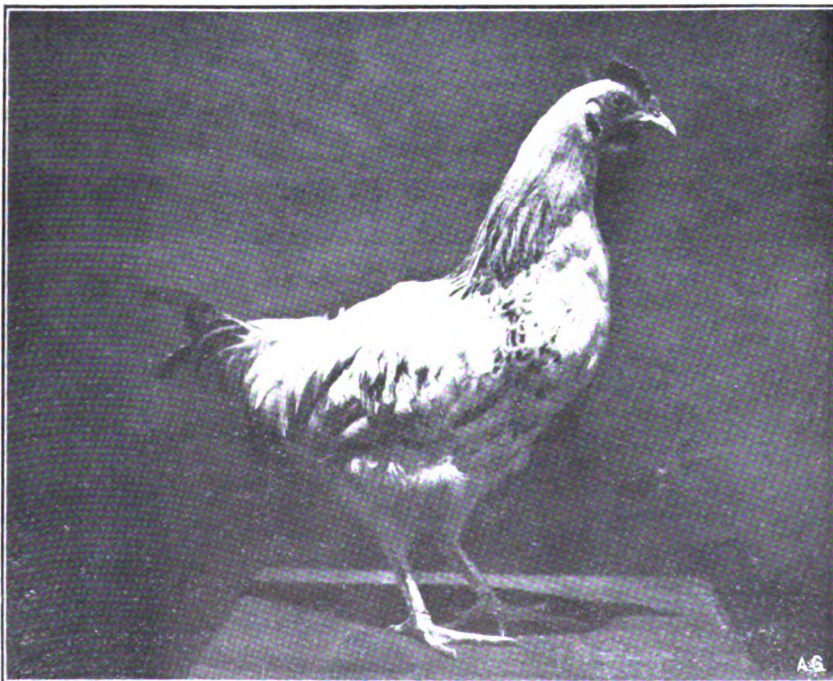


Fig. 4.—Cockerel No. 2, in October, 1926.

(Photographs by the Photographic Division, College of Agriculture)

PLATE II

plement. By February 15 the animal had greatly improved and by June 4 it weighed 1375 grams.

Cockerel No. 9. From the beginning of experimental feeding on September 25 this animal subsisted on polished rice, salt mixture, plus 5 grams fresh uray and 1 gram casein daily. The casein was incorporated with the uray. By December 14 its legs were very weak and the bird lay down most of the time. There was, however, little improvement in weight, only from 558 to 635 grams. So from this date the uray was replaced with sweet potato. As soon as sweet potato was given, the bird became lively. By January 11, it was normal in appearance and movement and weighed 850 grams. So sweet potato was withdrawn and uray was again given as supplement. On uray as supplementary feed, the fowl again declined physically. By February 5 the bird again had polyneuritis and weighed only 703 grams. So uray was for the second time replaced with sweet potato. After 10 days on sweet potato as supplement the appearance of the bird was much improved. By June 4 it weighed 1100 grams and was normally healthy.

Cockerel No. 10. This animal weighed 915 grams on September 25, 1926, and was given the same treatment as cockerel No. 9; that is, daily ration of 5 grams fresh uray and one gram casein, salt mixture, and polished rice. The weight increased slowly until by November 27 it was 1132 grams. From this date to February 1, more or less constant weight was maintained. By February 5, the weight dropped to 947 grams; by February 8 to 885 grams and the animal was distinctly polyneuritic. So the uray was replaced with 5 grams fresh sweet potato leaves and shoots. After four days on sweet potato there was much improvement in the appearance of the animal, although the weight had decreased to 780 grams. Then the weight began to increase. By June 4 the cockerel weighed 1395 grams and was normally healthy.

Cockerel No. 12. Beginning with September 15 this bird subsisted on polished rice and salt mixture *ad libitum* plus one-half cc. tikitiki and one gram casein daily. On October 5 its left leg was injured. On November 30 the left eye was swollen. During this period, there was no material change in the original weight of 560 grams. By December 12, the bird looked very sick, so the tikitiki was replaced with sweet potato. On the morning of December 13 the cockerel was found dead. Autopsy showed that it was suffering from other ailments besides polyneuritis.

Cockerel No. 17. This bird weighed 615 grams on December 18, 1926, when placed on a diet of polished rice, casein, salt mixture, gravel, charcoal, and filter paper. By January 25, 1927, it had polyneuritis, although there was only a little change in weight. Four days later, 5 grams of fresh sweet potato leaves and shoots were added as daily supplement; the animal soon appeared livelier. By February 12, it was normal in appearance. On June 4 the weight was found to be 900 grams.

Cockerel No. 18. This bird was given the same diet as No. 17. On December 18 it weighed 735 grams. By January 22 the weight had increased to 895 grams, which gradually decreased to 548 grams by February 22. At this time the bird had polyneuritis; so was given 5 grams fresh sweet potato leaves and shoots as daily supplement. On this diet, the fowl improved gradually and by June 4 it weighed 914 grams.

CONCLUSION

From the results here given, it is safe to conclude that sweet potato leaves and shoots form a good source of antineuritic vitamin, as well as the growth promoting water-soluble factor.

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THE GERMICIDAL PROPERTIES OF THE MIXTURE OF KEROSENE AND COCONUT OIL¹

ZACARIAS DE JESUS

Of the College of Veterinary Science

WITH ONE CHART

INTRODUCTION

A germicide is indispensable in a farmer's home. The average farm home in the Philippines does not have any of the well known powerful disinfectants which are used on up-to-date farms. If these are available few know how to use them, and are afraid because of their supposedly highly poisonous effects. It is then of practical importance to study the disinfecting or germicidal properties of some of the most common materials with which the average farmer is well acquainted. In almost every farmer's home there is always kerosene and coconut oil, as the former is used for illumination and the latter for hair dressing and medicinal purposes and also for illumination. Almost ever since the introduction of kerosene into this country, it has been known that this oil, applied either in pure form or mixed with coconut oil, gives highly satisfactory results in the treatment of bruises, wounds, ulcers, mange, lousiness, and skin diseases; and also for disinfecting hands, instruments, and tools which have been used in treating sick animals. Kerosene alone or mixed in sufficient quantity with coconut oil has an appreciable insecticidal and a deodorizing property.

Many investigators have reported the insecticidal property of kerosene when applied in the form of an emulsion with soap. As a fungicide, Porquez (1926) observed that molds were not affected by any treatment with kerosene, no matter what the length of the period of soaking. In his experiments, however, he mixed water with the kerosene.

When kerosene is applied in its pure form on the sensitive skin and on fresh tissues it is decidedly irritating, markedly dehydrating and may produce blisters. Coconut oil has a softening, soothing, and protecting action on the skin, as it is an emolient. Therefore an ideal way of applying kerosene on the skin is to mix it with coconut oil which acts as a corrective.

As kerosene and coconut oil are well known and cheap, the use of a mixture of the two as a germicide should be known so that it could be used judiciously and effectively. The following experiments attempt to show

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the germicidal properties of mixtures of kerosene and coconut oil with a view to finding the proportion that has the highest germicidal power, that is, the mixture that requires the shortest period of exposure to kill the bacteria.

These experiments were performed in the Bacteriological Laboratory of the College of Veterinary Science with the advice and encouragement of Dr. A. K. Gomez, Head of the Department of Pathology and Bacteriology.

MATERIALS AND METHODS

The Cock Brand kerosene was used in this study. It was selected because it is the brand most widely used in the Islands. A sample of one liter was taken from a newly opened five-gallon can by pouring directly into a clean dry bottle which was then corked tightly.

The four samples of coconut oil *langis* (Tagalog) used were prepared in the laboratory by the common native process. The fresh meat of the nuts was grated fine, and its milk was extracted repeatedly with water by pressing the coconut meat between the hands. The emulsion thus prepared was strained through a double layer of cheese cloth and boiled down in a vessel until the oil was straw color. The oil was then decanted from the brown coagulum and filtered through a thin layer of cotton. The samples were kept in a wide-mouthed bottle loosely covered with paper. Before using, the samples were sterilized in the Arnold steam sterilizer for a period of one hour at 100° C. on each of four consecutive days.

Different mixtures of kerosene and coconut oil were made in plugged sterile test tubes, 7" × 1/8", by varying the percentage of kerosene by volume in coconut oil at room temperature of from 28.5° C. to 29° C. Sterile 10 cc. pipettes graduated in tenths cubic centimeter were used in the measurements of the different volumes of the two oils. The mixture was poured back and forth from one test tube to another for at least ten times to thoroughly mix the oils.

Eberthella typhi Rawling, obtained through the courtesy of Dr. C. Panganiban of the Bureau of Science Serum Laboratory at Alabang, Rizal, was used as the test organism in the determination of the proportion of kerosene and coconut oil that has the highest germicidal power, and also with other experiments. It was cultivated on nutrient agar slant devoid of water of condensation.

As the materials under study are oils, the killing power of which against the test organism is far below that of phenol, neither the American Public Health Association standard methods of examining disinfectants (Park and others, 1918) nor the Rideal-Walker method could be closely followed. Hence, no attempt was made to determine the phenol coefficient of the mixture of kerosene and coconut oil. A method of preparing test objects for disinfection experiments given by Hill (1898) was followed at the begin-

ning of the work. As this method is really a modification of, and an improvement on, the well known method of Koch, and there was a possibility of employing it with oils, the writer tried this technic on eight trials. The results, however, were unsatisfactory as they varied greatly. Therefore, a modification of the standard technic was devised.

The seeding tube, $6'' \times \frac{5}{8}''$, was provided with a piece of glass rod, 10 mm. $\times$ 4 mm., to serve as bead. The tube was plugged with cotton and sterilized together with the bead in the hot air sterilizer for one hour at 160°C . Three cubic centimeters of oil or a mixture of kerosene and coconut oil were placed in the seeding tube, and about one milligram of the growth of a twenty-four hour old agar culture of *Eberthella typhi* Rawling was inoculated in the oil. By gently shaking the seeding tube to and fro for at least two minutes and holding the tube at an inclination of 60° , the bead broke the inoculum and spread the bacteria in the oil, thereby producing a uniform bacterial suspension and effecting a practically complete exposure of the individual cell to the action of the germicide. After a time interval of exposure, two three-mm. loopfuls of the oil bacterial suspension were transplanted to a tube of standard beef extract bouillon having a reaction of 1.5 per cent acid to phenolphthalein. The inoculated bouillon tubes were labelled properly and incubated at 37°C . for 48 hours.

EXPERIMENTS AND RESULTS

Experiment 1: On the determination as to whether or not the coconut oil acts as an adjuvant in its mixture with kerosene

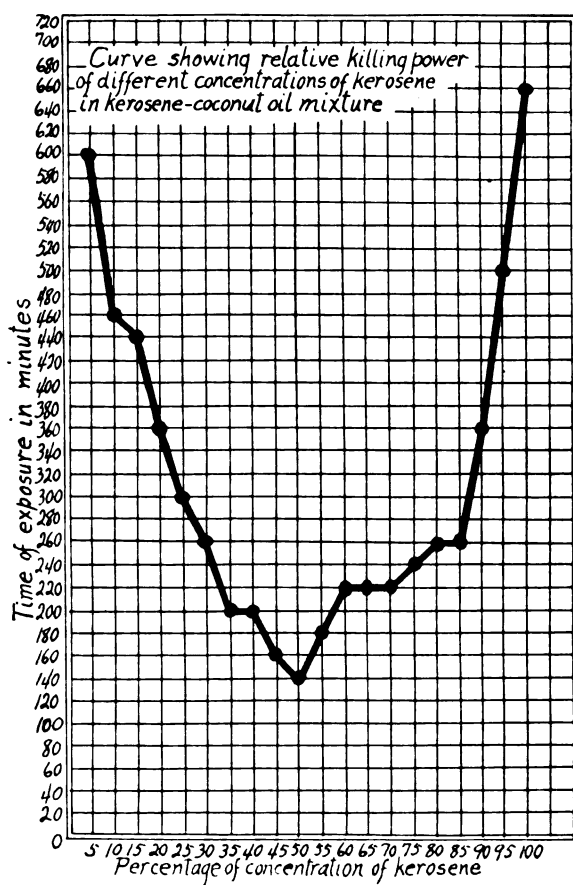
Three cubic centimeters of pure sterilized coconut oil, which was four months old, were placed in a seeding tube and inoculated with one milligram of the growth of a twenty-four hour old agar culture of *Eberthella typhi* Rawling. The seeding tube, described elsewhere in this paper, was shaken gently for three minutes so as to have a uniform bacterial suspension in the oil. The temperature was that of the room, ranging from 28.5°C . to 29°C . during the months of August and September, 1927. After a time interval of one hour, two three-mm. loopfuls of the coconut oil bacterial suspension were transplanted to a tube of beef-extract bouillon. This procedure was repeated ten times under similar conditions.

The results are shown in table 1. The sign (—) indicates total destruction of the bacteria with no growth in the media, and the sign (+) indicates lack of destruction of the bacteria with growth in the media.

Experiment 2: On the relative germicidal power of the different concentrations of kerosene in coconut oil

A sample of coconut oil similar to that studied under experiment 1 was used in this experiment. After the different mixtures had been prepared, three cubic centimeters of each mixture were placed in a seeding tube. The same technic as in experiment 1 was followed. The percentages appearing

in the first column of table 2 indicate the amounts of kerosene in percentage by volume in the different mixtures at room temperature, and the 100 per cent indicates the undiluted kerosene. These results represent the averages obtained from three to five and sometimes nine trials for each mixture carried out under as uniform conditions as possible. The 50 per cent concentration, or the 1 to 1 mixture of kerosene and coconut oil, showed the highest germicidal power as, compared with the other mixtures, it required the shortest time to kill the test organism. The experiment with this mixture was repeated eleven times with the object of verifying its relatively high germicidal power. The results are shown in table 2 and are presented graphically in figure 1. The abscissa represents the time of exposure of the test organism at an interval of 20 minutes, and the ordinate represents the concentration or the percentage by volume of kerosene in the mixture with coconut oil. Each point plotted in the graph (figure 1) indicates the shortest time for a mixture to completely kill the test organism.



Experiment 3: On the germicidal power of the 1 to 1 mixture of kerosene and coconut oil for various bacteria

As the mixture of kerosene and coconut oil is usually intended for external application, especially in the treatment of wounds, it was tested for its germicidal power on various pyogenic bacteria. Two species of the *Pasteurella* group were included in the test, just for comparison. These test organisms are maintained as stock cultures in our laboratory. They were subinoculated three days before being used.

As in experiment 2, the coconut oil used in this experiment was four months old. Equal parts of kerosene and coconut oil were mixed thoroughly at room temperature. The same technic as in experiment 2 was followed, with the exception of that with *Streptococcus hemolyticus* which was grown on blood agar slant and the transplants of its suspension in the mixture were made to tubes of serum water instead of that of beef-extract bouillon. The averages of the results are shown in table 3.

Experiment 4: On the effect of pure kerosene and the 1 to 1 mixture of kerosene and coconut oil upon the viability of anthrax spores

The same procedure was followed as in the previous experiments, except that the time interval was 24 hours. Two agar cultures of the Sisiman strain of *Bacillus anthracis*, one, 48 hours old and the other 13 months old, and also two agar cultures of the Los Baños strain of *Bacillus anthracis*, one, 48 hours old and the other 10 days old, were used in this experiment. These cultures were tested for the viability of the spores before used. The exposure of the spores to pure kerosene and to the 1 to 1 mixture was continued for 40 days. As the anthrax spores survived in pure kerosene and in 1 to 1 mixture of kerosene and coconut oil for a long period of exposure, it was necessary to determine whether they remained virulent by injecting their subcultures into susceptible animals. One cubic centimeter of the seventy-two hour old bouillon subculture, which was made from spores exposed to the action of kerosene and 1 to 1 mixture for different periods, was injected subcutaneously into four guinea pigs and two white rats. The results are shown in table 4.

Experiment 5: On the relation of the germicidal power of the 1 to 1 mixture to the age and acidity of coconut oil

Equal parts of kerosene and samples of coconut oil of different ages were thoroughly mixed, and three cubic centimeters of each mixture were placed in a seeding tube. The ages of the samples of coconut oil were 4 days, 30 days, 95 days, and 165 days. At these ages these samples had no odor indicating rancidity. All these samples were prepared in the laboratory and were kept under similar conditions. To determine the percentage of free fatty acids that might be present, each sample was titrated according to the method of Walker (1906) by dissolving five

grams of the sample of coconut oil in fifty cubic centimeters of neutral (to litmus) absolute alcohol and then titrating with N/10 sodium hydroxide. Phenolphthalein was used as an indicator. The average was taken from three titrations.

For the bacteriologic work the same technic as in the previous experiments was followed. The averages of the results are shown in table 5.

DISCUSSION OF RESULTS

Germicidal power of coconut oil

In all the ten trials, the four-month old coconut oil showed an appreciable germicidal action against *Eberthella typhi*. As shown in table 1, at room temperature of 28.5° to 29° C. the oil completely killed the test organism after an exposure of between 30 and 34 hours. This result clearly shows that coconut oil at a certain age is in itself a germicide and when mixed with kerosene it is not only a corrective but also a dependable adjuvant.

Lewkowitsch (1909) gives the following analysis of coconut oil:

Caproic acid.....	0.25 per cent
Caprylic acid.....	0.25 per cent
Capric acid.....	19.50 per cent
Lauric acid.....	40.00 per cent
Myristic acid.....	24.00 per cent
Palmitic acid.....	10.60 per cent
Oleic acid.....	5.40 per cent

A large number of samples, extending over a series of years, analyzed by Lewkowitsch, showed from 5 to 10 per cent of free fatty acids. Walker (1906) increased the acidity of a sample of pure coconut oil *langis* from 0.1 per cent to 8.63 per cent by adding 1 per cent of *latik* (Tagalog) (coagulum) and 1 per cent of water and then exposing the mixture to mold action in an incubator for one week. The same investigator pointed out that rancidity and free acid are not by any means synonymous.

Walker (1924) showed that capric acid, lauric acid, myristic acid and palmitic acid have an appreciable germicidal effect on the typhoid bacillus. It is then most probable that the action of the oil is largely due to the free fatty acids and in some degree to the difference in osmotic pressure between the bacterial cell protoplasm and the oil.

Relative killing power of the different concentrations of kerosene in coconut oil

As shown in table 2 and in the graph, the concentration of kerosene bears no relation to the germicidal power of the mixture. The killing power increases as the concentration increases from 5 to 50 per cent, but it decreases as the concentration increases from 50 to 100 per cent, that is, pure kerosene. It is evident that the 50 per cent concentration, or the 1 to 1 mixture, required the shortest period of time to kill completely the test.

organism, in other words it has the highest germicidal power. It is very possible that the two oils at this proportion can exert to the greatest advantage their combined killing power against the bacteria. Pure kerosene requires 640 minutes to kill completely the typhoid bacillus, but its killing power increases as it is diluted from 100 to 50 per cent with coconut oil. This shows that kerosene has its highest germicidal activity when it is in 50 per cent concentration in coconut oil.

Germicidal effect of the 1 to 1 mixture of kerosene and coconut oil for various bacteria

The 1 to 1 mixture of kerosene and coconut oil has an appreciable germicidal effect on several pyogenic bacteria. As shown in table 3, it takes 160 minutes to completely kill *Streptococcus hemolyticus*, 200 minutes to kill *Staphylococcus pyogenes aureus*, 220 minutes to kill *Staphylococcus pyogenes albus*, 180 minutes to kill *Pseudomonas pyocyaneus*, 210 minutes to kill *Pasteurella aviseptica*, and 180 minutes to kill *Pasteurella suissepica*. It is to be anticipated, however, that with increase in age of the coconut oil the killing strength of the mixture will naturally be increased.

However low the germicidal power of the mixture may be it can be relied upon to a certain extent as a germicide in the treatment of wounds or other microbial skin diseases. In the first place, the presence of coconut oil prevents rapid evaporation of the kerosene and being an emolient and a germicide it acts as a corrective as well as an adjuvant. In the second place, the mixture is neither strongly toxic nor irritating so that it can be applied repeatedly or continuously without fear of any deleterious effect on the patient.

Should it be intended to apply the mixture extensively or on the whole body, being an oil mixture, the species of the animals must be taken into consideration, especially animals that respire through the skin. The writer applied the mixture repeatedly for three days on one-half of the surface of the body of four guinea pigs and one rabbit in treating suppurating bruises and lacerated wounds, incident to fighting. The wounds healed in four days and no after effect was ever manifested by the animals.

In the treatment of wounds with this mixture it is recommended that no water or disinfectant should be used in cleaning the wounds. The proper way is to clean the wounds with a piece of cotton soaked in the mixture. Then apply the mixture as thick as possible. As the mixture is inflammable, the soiled pieces of cotton can be burned easily and this will aid in preventing the dissemination of an infectious skin disease.

Effect of pure kerosene and 1 to 1 mixture of kerosene and coconut oil on anthrax spores

The spores of *Bacillus anthracis* are not affected by either the pure kerosene or the 1 to 1 mixture of kerosene and coconut oil. The results

showed that the spores remained alive even after an exposure of 40 days, and their virulence as shown in table 4 is not by any means affected. The amounts of growth in the subcultures did not vary according to the different periods of exposure. This shows that the spores remained dormant in pure kerosene and in the 1 to 1 mixture of kerosene and coconut oil. The guinea pigs and white rats that were infected subcutaneously with the growth of the subculture of spores, which were either exposed to pure kerosene or to 1 to 1 mixture, died in from 36 to 72 hours.

Relation of the germicidal power of 1 to 1 mixture to the age and acidity of coconut oil

Table 5 shows that the acidity of the coconut oil varies with the age, and, in turn, the germicidal power of the mixture varies with the age and acidity of the coconut oil. The germicidal efficiency of kerosene is considered as constant. These results are not regarded as very conclusive because of the limited data on hand. Further experiments on this phase of the subject are in progress and will be carried on for a year or more as the results warrant. These results are included in this paper only to offer an explanation for the relation of the germicidal power of coconut oil to its age, and consequently its acidity, since it plays an important rôle as an adjuvant in its mixture with kerosene. However, taking the germicidal action of kerosene as constant, these results show that the acidity of coconut oil is an index of its germicidal efficiency.

SUMMARY OF CONCLUSIONS

1. Coconut oil, prepared by the process common in the Philippines, on standing for several months, has a germicidal effect on the typhoid bacillus and this germicidal activity increases with age. When coconut oil is mixed with kerosene it acts not only as a corrective but also as an adjuvant.

2. The mixture of equal volumes of kerosene and coconut oil, or the 1 to 1 mixture, has a higher germicidal power than other proportions of the two oils or than either one of them in pure form.

3. The 1 to 1 mixture of kerosene and coconut oil, which is several months old, has an appreciable bactericidal efficiency against certain pyogenic bacteria, as the *Streptococcus hemolyticus*, *Staphylococcus pyogenes aureus* and *albus*, and *Pseudomonas pyocyaneus*.

4. Both the pure kerosene and the 1 to 1 mixture of kerosene and coconut oil have no effect whatever on the spores of *Bacillus anthracis*, even after an exposure of forty days.

5. The mixture of kerosene and coconut oil should not be regarded as a general germicide. Its germicidal effect, however, on the most common pyogenic bacteria can be relied upon to a certain extent in the treatment of wounds and some microbial skin diseases and in minor operations. Kero-

sene, being an insecticide, the mixture should be of great value in the treatment of scabies and lousiness.

6. Since the mixture of kerosene and coconut oil can remain for a considerable length of time on the surface of objects and hands, its use as a germicide, despite its low germicidal efficiency, can be taken advantage of in the absence of standard powerful disinfectants.

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trols

CON- CEN- TRA- TIONS										CON- TROLS
	20	40	60	80	640	660	680	700	720	72 hr.
<i>per cent</i>										
5	+	+	+	+	—	—	—	—	—	—
10	+	+	+	+	—	—	—	—	—	—
15	+	+	+	+	—	—	—	—	—	—
20	+	+	+	+	—	—	—	—	—	—
25	+	+	+	+	—	—	—	—	—	—
30	+	+	+	+	—	—	—	—	—	—
35	+	+	+	+	—	—	—	—	—	—
40	+	+	+	+	—	—	—	—	—	—
45	+	+	+	+	—	—	—	—	—	—
50	+	+	+	+	—	—	—	—	—	—
55	+	+	+	+	—	—	—	—	—	—
60	+	+	+	+	—	—	—	—	—	—
65	+	+	+	+	—	—	—	—	—	—
70	+	+	+	+	—	—	—	—	—	—
75	+	+	+	+	—	—	—	—	—	—
80	+	+	+	+	—	—	—	—	—	—
85	+	+	+	+	—	—	—	—	—	—
90	+	+	+	+	—	—	—	—	—	—
95	+	+	+	+	—	—	—	—	—	—
100	+	+	+	+	+	—	—	—	—	—

IS THERE A SOLUTION?¹

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The annual unwelcome downward trend of prices for tobacco since 1920 has brought much suffering to our tobacco farmers. The cause of this falling of prices is the practically dormant market for tobacco abroad coupled with the nearly constant or increasing production in the principal tobacco regions of the world. The demand for Philippine tobacco in the United States, our greatest market, has declined considerably during the last few years.

In the province of Cagayan, the weekly newspaper, *Verdad*, has repeatedly warned the *cosecheros* of this dangerous economic situation caused by the low prices of their tobacco. The farmers know this. They know that the price offered for their crop is very low; so low that the total returns they receive for their year's labor and trouble is not enough to cover even fifty per cent of the total expenses incurred in producing the product. The farmers are now feeling the depressing effect of this situation. The majority of them cannot pay the tuition fees for their children who are in school; they cannot even prepare their fields for the next year's crop for lack of money; and far worse, some do not have the money to buy the everyday necessities.

Is there a possible remedy for this discouraging situation? What are the possible cures for this "economic malady"? It is the purpose of this paper to point out the causes for this "economic illness" and to suggest a possible remedy. It should be kept in mind, however, that the writer will attempt only to suggest possible cures. He does not claim that the remedies will effect permanent cures, but he believes that if some of them will be followed they will help a great deal in bringing about a healthier condition for our poor tobacco farmers.

SOME CAUSES FOR THE ECONOMIC CONDITION OF OUR TOBACCO FARMERS

First, the causes for any sickness should be known before any prescription can be made. Let us consider then what has brought about this depressing economic condition among our tobacco growers. Some of these causes are:

1. Too much dependence on one kind of crop.
2. Lack of organization among the farmers, a condition which prevents their being strong enough to influence the fixing of prices for their crop.

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3. The buying companies in the province take advantage of the weakness of the unorganized tobacco farmers.

4. Neglect on the part of the growers to improve the quality of their product.

Now, how does each of these causes help bring about the "sickness"?

Too much dependence on one kind of crop. Our farmers in the tobacco region put so much dependence on tobacco that if they fail to sell their product they become financially crippled and helpless. This forces them in the clutches of unscrupulous money lenders, or usurers. Once they become debtors to these merciless individuals, they have a very hard time to pay their debts, for the rates of interest are exorbitant, the annual interest oftentimes amounting to more than the original money borrowed. For this reason it is not uncommon to find tobacco farmers who produce tobacco from year to year solely for their creditors.

Dependence on one kind of crop, especially upon a crop that cannot be utilized for food, is very dangerous. The tobacco buyers know that these farmers need rice and other necessities, and that they use the money they get for their tobacco crop to buy them, that unnaturally they take advantage of the situation and do not buy the tobacco until they know that the tobacco growers are in dire need of money, and will agree to the terms they offer them for their crop. Because tobacco is practically the only cash crop of these farmers, they are driven to the wall when no one offers to purchase their produce.

Lack of organization among the farmers. There is no union, no strength to enable the tobacco farmers to influence the fixing of prices for their crop. Each sells his own tobacco to the tobacco buying companies or to individual tobacco buyers in the province. In other words, there is a keen competition between these farmers in selling their product. They undersell each other.

Economists teach that one of the results of competition is that it brings about a uniform price for a commodity on the market, and that this price is influenced to a certain extent by the demand and supply. Knowing this price is helpful to the farmer because it shows him how much of any one commodity he should produce the next season. If the price offers him a wide margin of profit, he naturally endeavors to produce more of the commodity than when the price is such as to barely reimburse him for his expenses in producing it. But this advantage of knowing the price holds good only when the farmer knows how much he spends in producing the commodity. If he does not know his cost of production, how can he know whether he is making profits or not out of his produce when it is sold at a certain price?

Unfortunately, a large majority of the tobacco farmers do not know exactly how much it costs them to produce a unit of weight of tobacco. Consequently, they cannot tell in advance how much tobacco they should produce the next season, so each produces as much as he can. This may

bring about over-supply, which with the usual competition among themselves, means selling at a very low price—so low that the cost of production is not covered. This explains why the majority of our tobacco farmers lose from 30 to 40 per cent of the money they invest in the production of tobacco. If these farmers were organized, if they had a union among themselves, they would not undersell one another, thus one cause of low prices would be eliminated.

The companies buying tobacco take advantage of the unorganized farmers. These companies are very powerful. They have a wide knowledge of the condition of the demand and supply of tobacco on the world's markets. Consequently, they know exactly the price they should offer to the farmers; a price that might be advantageous to them. But these buyers know that these farmers make no effort to learn about market conditions, that they are wholly ignorant about such things. Hence, the buyers, being human, offer the farmers prices very much lower than they could well afford to give. Their agents bargain with the farmers and often wait until the time when they can no longer hold out. Thus, generally when prices of tobacco in Manila for Cagayan tobacco is, say, ₱16 a quintal, it is ₱8 to ₱12 or even less in Cagayan.

Because these buyers are well organized, they can shift the advantage of the bargaining to their side. For example: Before the opening of the buying season one of the leading companies quotes, say, ₱16 a quintal as the highest price it can afford to pay. The other companies learn of this through their agents, or *corredores*. In the buying season the buyers always offer a price ₱2 to ₱3 lower than the maximum set by the leading company. Buyers compete and the farmer not knowing the maximum price tries to bargain, putting one against the other. But as the farmer needs cash, in the end he sells for around ₱14 instead of ₱16. This will never be otherwise with one farmer, ignorant of what could be paid, trying to meet single-handed organized companies conversant with the world markets.

In almost all cases, except when dealing with the co-operative marketing association of Tuguegarao and its branches, the buying companies fix the prices paid the farmers for the tobacco. The ignorant unthinking farmers go on raising as much tobacco as they can, thereby lowering the quality and consequently the price of the article. And by indirectly causing this are the buyers not just as blind as the farmers?

Poor quality of product. A careful analysis of the conditions existing in the tobacco region of Cagayan Province will reveal that the farmers are partly to blame for their present depressed economic situation. They do not take pains to improve the quality of their tobacco. Some time ago, a representative of one of the largest tobacco buying companies in the Cagayan Valley stated in *Verdad* that these farmers could get better prices for their crop if they only would raise a good quality of tobacco and classify it according to the old method used during the Spanish Tobacco

Monopoly; that is, classifying the leaves into "hands" or bundles, each containing 100 leaves of nearly the same size and quality. The *casas*, or companies, would be willing to pay more for the tobacco arranged in this manner because they would be saved the trouble of reclassifying it in their warehouses where it is baled and made ready for shipment to Manila. But the farmers have not heeded this advice. They still carry on competing in the amount of leaves they turn out from a unit of area of land, not taking into consideration the greater monetary returns they would get from the same area if they improved the quality of product. These farmers are also very careless in curing the tobacco leaves. They cure them, in most cases, in any convenient place, sometimes in their houses, sometimes under them, or under the trees. There are very few who can afford to cure their tobacco under sheds built for this purpose. As a result of this undesirable practice the farmers get low prices for their product.

Of course, their excuse is that they get the same price for their tobacco regardless of quality. Leaves carefully cured sell for the same price as leaves carelessly cured. This means no wages for extra work. This is true, but they lose because buyers reject the poorest leaves which usually compose from fifteen to as high as fifty per cent of a farmer's total produce. But this difficulty could be remedied easily if the farmers would co-operate and try to produce as good a quality as possible. And if they can exert any influence in the fixing of prices through a mutual understanding among themselves, so much the better.

POSSIBLE SOLUTIONS

After learning the possible causes for any disease, the next thing is to determine the possible cures for that disease. In the foregoing paragraphs, I have tried to point out the possible causes for the depressing economic condition which the tobacco farmers are facing, and the way each of these might have brought about the "economic illness". Now, what prescriptions might bring about its cure? I shall try to give what seems to me might be possible cures. These are:

1. Organization among the farmers for co-operation.
2. Limitation of the number of tobacco plants raised by each farmer with a view to improving the quality of the product.
3. Diversification of crops.
4. Raising food crops, such as rice, corn, etc., instead of tobacco.

Organization among the farmers. The tobacco farmers could strengthen their position by organizing into co-operative associations. They would then be able to exert an influence in the fixing of prices for this commodity and stop the bad practice of underselling one another. There is a co-operative marketing association functioning in Tuguegarao with branches in Solana, and Peñablanca, but not all the tobacco farmers are members of this association. The majority are still fighting the movement. They

are still competing with this association instead of supporting it. If supported by all tobacco farmers in the region, the association should be able to bring about real results that would bring them relief. It could afford them credit facilities, improve the quality of production, bring about better prices for the crop, etc., and above all it would strengthen their voice when asking aid from the government.

Those good things which a co-operative association would bring to the tobacco farmers are not dreams. The co-operative marketing association of Tuguegarao has already shown to its members that these benefits are really obtained by members of this organization. In 1925-26 this association was able to accumulate ₱12,002.00 from commissions which it received from companies that bought its tobacco, a large sum of money that, without the association, would have gone to the pockets of the middlemen buying tobacco for these companies. The association used the fund to help its members out of financial difficulties by extending them loans at nominal rates of interest. The association, too, advanced money to pay taxes for several of its members who were not able to do so owing to delay in the sales of their tobacco or to the low prices received. Besides this visible help rendered, the members learn a great deal regarding the improvement in the methods of farming and marketing. The association has been able to obtain better prices for the tobacco of its members than was offered for the same quality belonging to non-members. This it was able to do despite the presence of many farmers in the municipality who are not members of the association and who tried to compete with it in selling their tobacco.

If the tobacco farmers want to improve their economic condition the best thing is to form co-operative marketing associations or support or be members of the one already functioning in Tuguegarao. In that way they can demand from the buyers the prices which they deserve as primary producers of the commodity, prices which they have heretofore not demanded owing to lack of information.

Limitation of the number of plants. To improve the quality of his product, each farmer should plant only as many tobacco plants as he can efficiently handle. The success of this remedy depends upon one of two things; namely, (1) the willingness of the farmers to carry it out by themselves, or (2) the enforcement of a law enacted to compel them to do this.

If the farmers were all members of a co-operative organization they could easily carry out the limitation. The members generally sign a contract with the organization one of the provisions of which should require each member to plant only the number of plants that can be taken care of by him, efficiently. The contract should also require that the produce from these plants should be cured, fermented, and classified under the rules and regulations formulated by the Board of Directors of the association. This is, I believe, the most effective way of applying this remedy.

If the farmers do not want to form co-operative associations, they can be made by law to limit the number of tobacco plants they cultivate. A law could be enacted requiring each farmer to plant, say, 6,000 plants. He should cure, ferment, and classify the produce from these plants in accordance with the rules and regulations that are now enforced by the Bureau of Internal Revenue. But in this law a minimum price should be fixed for each grade of tobacco so classified. This will insure the wages of the farmers for the extra effort and trouble in producing better quality of product.

Diversification of crops. The planting of two or more crops on the farm during the same season is called diversified farming. This practice is followed usually to avoid losses from failure or low price of one crop. The farmer who depends entirely on one crop must always be prepared to stand heavy losses; in years of plenty he must save for years of scarcity. Localities, too, that depend largely on a single product are subject to years of abundance and years of hard times.

The tobacco districts in the Cagayan Valley are no exceptions to this rule. In 1914-19 there was general prosperity on account of the high prices of tobacco. Since 1920, however, the low prices of tobacco have brought hard times. The price of this commodity is now so low that the average farmer is not able to sell his produce at a price to cover cost of production. And this year he cannot dispose of his crop at any price because there is practically no demand for it.

Now, the best remedy for this situation is for the farmer to plant other crops along with tobacco; resort to diversified farming. He should plant food crops, such as rice or corn with tobacco so that when he is not able to sell his tobacco he will at least have food; moreover, if the price of tobacco is very low he can store it and wait better prices. Having his own food supplies will also free him from getting into the clutches of unscrupulous money lenders.

The small area, only about one and one-half hectares on the average, handled by a tobacco farmer is a drawback to diversified farming. This area is too small to allow him to plant enough food crops along with tobacco for his family to depend upon when he is not able to sell his tobacco produce. But, even so, growing what he can will teach him that other crops are worth growing,—a knowledge which may be helpful to him when the time comes when he has no other course left but to entirely abandon the raising of tobacco.

Raising food crops instead of tobacco. Corn is the secondary crop in the tobacco region. Rice also grows very well on the tobacco land. If the production of tobacco no longer gives the farmer proper return after his best endeavor has been given it, why should he persist in raising this crop? Why should he spend the best years of his life in an unproductive enterprise? If you ask the average farmer this question, he will answer,

"I have been accustomed to raising tobacco. It was the occupation of my forefathers, my father. I simply cannot give it up, though I know that it does not pay".

But should the farmer not take a more common sense view of the situation? I believe that should he raise rice or corn it would pay him. He produces tobacco for the foreign market. He can not utilize it for food, if he cannot sell it. And if he is able to sell it the money he receives from the sale is hardly enough to pay for his food and other bare needs. If he raises rice or corn, he produces it for the local market. He finds ready sale for his surplus because it is a food crop for which there is always a steady demand. If he produces only enough for his consumption, he will not be in as a bad a position as when he depends entirely on tobacco because he will have food at least, the primary need of any human being.

SUMMARY

The causes for the depressing economic condition which the tobacco farmers are facing have been enumerated as:

1. Too much dependence on tobacco which renders the farmers helpless, financially crippled, when low prices accompanied by a small demand for this commodity occurs.

2. The farmers, being unorganized and ignorant of their cost of production, have no influence in the fixing of prices for their product; this is done by the buying companies. Because they undersell one another, the farmers are always paid prices much lower than what the buyers can really afford to pay.

3. The buyers bargain with the farmers because they know that they are ignorant of the condition of demand and supply of tobacco on the market. These buyers always succeed in shifting the advantage of the bargaining to their side because it is a case of a farmer ignorant of market conditions meeting single-handed a powerful business organization.

4. These farmers do not take pains in improving the quality of their product, consequently they do not get the prices commensurate with the labor and trouble they expend in producing the article. Besides a part of their total production, ranging from fifteen to as high as fifty per cent, is rejected by the buyers because of its being unfit for use.

But this discouraging situation is not by any means permanent in nature. These farmers could improve their economic condition by using common sense and applying certain remedies that would tend to alleviate their suffering. Different remedies have been suggested:

1. The farmers should organize into co-operative associations which might accord them credit facilities, improve their production, secure better prices and facilitate marketing of their crop, and strengthen their voice when asking aid from the government. They should become members of the

co-operative marketing association already functioning in Tuguegarao if they want to improve their economic condition, for if supported by all of them this association will surely bring to them relief.

2. If they do not see the advantages derived from membership in a co-operative organization, they could get better prices by improving the quality of their crop. If they cannot do this voluntarily, a law could be enacted that would require each of them to cultivate only, say, 6,000 plants to be cured and classified under the regulations now enforced by the Bureau of Internal Revenue. But, maximum prices should be fixed in this law for every grade of tobacco they produce, thus insuring wages for the extra effort they exert in turning out a good quality of product.

3. Failing in the above, these farmers can still improve their condition by resorting to diversified farming, planting food crops along with tobacco so that when they cannot sell this commodity they will at least have food while waiting for better prices. This practice will also teach them that it pays to raise other crops.

4. If these tobacco farmers find that growing tobacco no longer is a paying proposition they can stop producing this commodity and resort to planting food crops, crops that always are in a steady demand and have a ready market at home. Such a step would bring about healthier conditions for these poor farmers than taking chances on tobacco which requires a knowledge of world markets, instead of knowledge confined to the information they get from the buyers of their product.

I have presented these causes and possible remedies for the depressed economic situation which the tobacco farmers are facing. I do not claim that one particular remedy is the best. That I shall leave to the judgment of the farmers concerned. I personally believe, however, that any one of the remedies suggested can be applied in the tobacco regions, but as to which of them is the best depends upon the way the farmers look at the situation.

A STUDY OF (P. B. 119×C. A. C. 87) F₁ HYBRID AND OTHER SUGAR CANE SEEDLINGS AND THEIR PARENTS¹

EUFRAIN M. MORALES

WITH SIX TEXT FIGURES

Among our Philippine crops, sugar cane is one that can be easily improved through the production of new varieties by hybridization. Once a new sugar cane variety is produced, it is easy to fix its characteristics, for the sugar cane plant is usually propagated by cuttings, especially by points.

There are various methods of improving the sugar cane and one of these methods is the production of seedling varieties. It is generally believed that plants grown from seeds exhibit a greater number of variations than those propagated asexually. A combination of desirable characters of two parent varieties may be obtained through cross-breeding. The hybrids generally show useful variations and the best ones may be selected and fixed by vegetative propagation. It is said that superior seedling varieties do not maintain their superiority for many generations as there is a tendency toward "senile degeneration". Superior seedling varieties, therefore, should be raised so as to have a continuous supply. By this means a high level of production can be maintained.

Review of past work with the parent varieties

Very little work has been done with C. A. C. 87 variety and especially with P. B. 119. Sumagit (1926) found that the diameter of the stalk at six months old and at about a year old were practically the same. In the width of the leaf, the typical width at the early stage was less than that at maturity. Blooming began at 309 days after sowing and stopped 30 days later. At maturity the most common color was purple but the typical color of the seedling was yellow. The average percentage of total solid computed was 14.47.

It was observed by Mercado (1926) that C. A. C. 87 even when planted in different plots and at different periods flowered at the same time; from November 4, 1925, to February 6, 1926. It took 11 days for the flower to send its whole arrow out, and it shed its pollen about 4 days after the appearance of the tip of the arrow. Most of the flowers opened 7 days after shooting and the seeds ripened in 22 days after the tip of the arrow had been exposed. On sunny days, the flowers opened earlier than on cloudy

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days and remained open for seventeen and one-half minutes. Mature arrows gave a higher percentage of germination than those collected while immature. The variety gave the best germination in from 22 to 24 days from shooting to the cutting of the arrow.

Mendiola and Unite (1924) reported the following analyses of C. A. C. 87 made at different dates and in different years by the Chemistry Department:

	DATE OF ANALYSES		
	Nov. 2, 1922	Nov. 9, 1923	Dec. 3, 1923
Percentage of sucrose in cane.....	7.22	10.44	9.85
Gravity purity of first expressed juice.....	84.29	84.74	81.01
Quality ratio.....	1:15.6	1:10.6	1:11.8
Percentage of fiber in cane.....	12.15		

Mr. A. P. Goseco, formerly of the Pampanga Sugar Development Company, found that 17.62 tons of cane of C. A. C. 87 was needed to make one ton of sugar. The manager of the U. P. Sugar Mill reported the quality ratio of C. A. C. 87 to be 15.15 to 1. The quality ratio was calculated on standard central practice with 96 per cent sucrose extraction, 30 per cent purity of final molasses, and 96.5 per cent polarization of commercial sugar.

According to the analyses made by the U. P. Sugar Mill during the College milling season 1925-1926, the following was reported for the P. B. 119:

Tons cane ground.....	1.005
Brix of first mill juice.....	17.66
Polarization.....	14.80
Apparent purity.....	83.8
Tons cane per ton sugar.....	9.98

The quality ratio is calculated by assuming an extraction of 94.0; a Java ratio of 83.0; a Polarization of sugar, 96.5; a Purity of sugar, 97.5; and a Gravity Purity of Final molasses, 38.0

OBJECTS OF THE PRESENT WORK

The objects of this study were: (a) To study variability in characters of agronomical importance of supposedly hybrid seedling canes (P. B. 119 × C. A. C. 87) F₁; and (b) to study the possible importance of varieties involved as sources of useful hybrid seedling varieties.

This investigation was begun in April, 1926, and closed in January, 1927. The work was performed in the Nursery and Multiplication Field of the Plant Breeding Division, College of Agriculture, Los Baños, Laguna.

MATERIALS AND METHODS

Varieties used

The materials used in this study were the supposedly (P. B. 119 × C. A. C. 87) F₁ hybrid seedlings, naturally-selfed seedlings of P. B. 119, and the parent plants, P. B. 119 and C. A. C. 87. The supposed hybrid (P. B. 119 × C. A. C. 87) F₁ and P. B. 119 naturally-selfed seedlings were grown from seeds collected in the arrowing season of 1925.

The C. A. C. 87 which was used as male parent is described by Mendiola and Unite (1924) as follows: "This is a medium sized cane, very long jointed, hard and erect. The stalk is reddish when young, but the red color gradually disappears as the plant becomes older. At maturity the stalk is yellow with some patches of slight red remaining. This variety was selected for its vigorous growth habit, its hardy qualities, resistance to the serious diseases found on the Philippine standard varieties, and its resistance to the bending effects of typhoons".

The P. B. 119 cane is one of the six selected seedlings of Badila parentage produced in the 1920-1921 season. It is a heavy and soft cane. The color of the stalk when young is brownish green, turning dirty brownish green with burnt sienna when mature and exposed to sunlight. Its internodes are usually longer than those of Badila and crack occasionally; eyes are fairly well developed; and longitudinal linings are present all over the surface of the rind of the internode. It is self-trashing and produces an average of five stalks a stool. Although it is attacked by mosaic and leaf spots it has been selected for its exceptionally large size and fairly high sucrose content. It tassels very freely.

The asexual offspring of the 1925-1926 selected seedlings were also studied for their agronomical characters. These clons were known by their P. B. numbers. The Louisiana Striped selected seedlings were given P. B. 151 and P. B. 152; H-227 seedlings, P. B. 153 and P. B. 154; Badila



Fig. 1.—(P. B. 119 × C. A. C. 87)F₁ hybrid seedlings showing variability in the number of stalks. (1) Hybrid seedling No. 2381. (2) Hybrid seedling No. 2380. Selected. (All photographs for this paper taken by the Photographic Division, Department of Agronomy, College of Agriculture.)

seedlings, P. B. 155, P. B. 156 and P. B. 157; and Cebu Purple, P. B. 158, P. B. 159 and P. B. 160.

Procedure of raising seedlings

The hybrid seedlings were grown from the seeds of P. B. 119 pollinated with C. A. C. 87. The method of cross-pollination used was as follows: During the blooming of the flowers, the arrows of C. A. C. 87 were shaken over the arrows of P. B. 119; also pollen collected from C. A. C. 87 plants and placed in a paper bag was dusted over the arrows of P. B. 119. The naturally-selfed seedlings were raised from P. B. 119 arrows which had not been artificially pollinated.

When the fuzz began to shatter, the seeds were collected and placed in paper bags for a few days to dry. They were germinated in seed boxes with a layer of soil of about ten cm. in depth. The soil used was ordinary field soil, sterilized in an open pan and then sieved. The fuzz was spread uniformly on the surface of the soil and kept moist. The germination boxes were covered with sheets of glass and kept exposed to sunlight. Within a week the plants began to appear.

The seedlings were from about 5 to 10 cm. tall when they were pricked into seed boxes where the soil was about 15 cm. deep. The pricked seedlings were transplanted to nursery plots and to the field when they were from 30 to 50 cm. high. They were planted 75 cm. apart in the row and the rows were one meter apart. Transplanting began in the middle of April and ended in the early part of May, 1926. The seedlings were watered daily for a month after transplanting. When the seedlings in the Nursery were about three months old, five grams of ammonium sulfate, $(\text{NH}_4)_2\text{SO}_4$, were applied around each plant in a trench about 5 cm. deep. In this connection, it should be remarked that the seedlings grown in the Multiplication Field were not fertilized because this field had been planted to soybean which was plowed under, prior to planting the seedlings.

A total of 2000 seedlings was used in this study; 1500 of which were supposedly hybrids, (P. B. 119 $\times$ C. A. C. 87) F_1 and 500, P. B. 119, naturally-selfed seedlings. The seedlings were numbered with tin labels, the hybrids from 946 to 2446, and the P. B. 119 naturally-selfed seedlings, from 2447 to 2945. The seedlings labeled from No. 946 to No. 1690 were planted in the Plant Breeding Nursery and the others in the Multiplication Field.

*Determination of variability among the seedling plants at the age
of about one year*

The variability in the following characters was observed on the seedlings about twelve months after sowing.

Color of stalks. The stalks were described as purple, rosy, and flesh colored.

Habit of growth. The plants were observed as to whether their stalks were erect, reclining, lodging, open or closed.

Average height of stalks. The height of a representative stalk of the millable stalks of each seedling was measured from the base up to the point where the cane top is severed.

Average diameter of stalks. The thickness of the middle of a typical millable stalk of each plant was measured with a Vernier caliper.

Average length of internodes. The internode at the middle of a representative stalk was measured.

Position of leaves. The seedlings were grouped as to whether their leaves were upright or bending.

Hairs on leaves. The presence or absence of hairs on the leaf sheaths was noted.

Millable and unmillable stalks. The number of millable and unmillable stalks of each seedling was noted.

Presence of diseases and pests. Diseases were observed on the leaves, stalk, and other parts of the plant.

Total weight of stalks. The weight was determined by weighing on a balance all millable stalks of each stool after the tops have been removed.

Determination of total solids. The percentage of total solids was determined with a Bausch and Lomb Abbe refractometer. The method of determination was as follows: From the third internode of the main stalk of each stool, juice was extracted and placed between the upper and lower halves of the prism of the refractometer. After making a few adjustments of the refractometer, the refractive index was read on the graduated scale under the eyepiece. The temperature of each determination was recorded from the thermometer attached to the upper mount of the prisms. The control of temperature was accomplished by allowing cool water to circulate around the prisms of the refractometer, when the temperature prevailing during the time of determination rose above 29°C., and heated water when it fell below 27°C. With a conversion table, the per-



Fig. 2.—(P. B. 116 × C. A. C. 87)F₁ hybrid seedlings showing variability in habit of growth. (1) Hybrid seedling No. 2150, closed. (2) Hybrid seedling No. 2152, open.

centage of total solids corresponding to each refractive index and temperature of the determination was computed.

Experiments and results

Though grown in two separate places, the seedlings under study were subjected to almost the same conditions, especially as to soil.

The culture was still in progress in 1926 when in the night of November 5 a typhoon of unusual intensity occurred, lasting nearly the whole night. All the plants were blown down, but only a few were entirely uprooted. The day after the typhoon, observations on the extent of the damage were made, and rehabilitation work was begun. Each plant was restored to its normal position by ridging and slightly pressing the soil around the base. A week after this treatment, the seedlings were observed to have recovered from the bending effects of the typhoon and when the observations on the different agronomical characters were performed, the plants were apparently in normal condition. These observations were made between December 18, 1926, and January 5, 1927.

The data on number of millable and unmillable stalks, color of stalks, habit of growth, position of leaves, presence or absence of hairs on leaves, prominence of buds, presence of diseases and pests, and the measurements of the average height, diameter, and length of internode of all millable stalks of each stool were gathered at the same time. The determination of total solids was performed by analyzing three hundred samples a day. At this rate, the analysis was completed in about a week. The determination of the tonnage of each seedling was made after the observations on all other agronomical characters were completed. The seedlings infected with Fiji disease were noted but not studied with regard to all other characters.

Parts of the results of this investigation are shown in tables 1 to 4, inclusive.

Table 1 is a summary of the field observations on the habit of growth, color of stalk, position of leaves, presence or absence of hairs on leaves, and prominence of buds, of (P. B. 119 $\times$ C. A. C. 87) F_1 hybrid and P. B. 119 naturally-selfed seedlings.

Table 2 gives the extent of damage by the different diseases observed on the seedlings.

Table 3 shows the comparative agronomical characters of the parents, the supposed hybrid and P. B. 119 naturally-selfed seedlings.

Table 4 shows the comparative agronomical characters of the 1925-1926 F_1 selected seedlings in their sexual and first asexual generations.

TABLE 1
Summary of the field observations on the different characters of the seedlings

KIND OF SEEDLINGS	HABIT OF GROWTH					COLOR OF STALKS			POSITION OF LEAVES		HAIRS ON LEAVES		PROMINENCE OF BUDS		
	Open	Close	Erect	Reclin- ing	Lodging	Purple	Rosy	Flesh	Upright	Bending	Present	Absent	Non-promi- nent	Promi- nent rounded	Promi- nent pointed
P.B. 119×C.A.C. 87) . . .	160	1299	856	594	9	928	191	340	1016	443	1057	402	551	759	149
P.B. 119 naturally selfed	79	419	237	254	7	317	82	99	382	116	340	158	74	385	39

TABLE 3
Summary of the important agronomical characters of the parent plants, (P. B. 119 × C. A. C. 87)F₁ hybrid and P. B. 119 naturally selfed seedlings

VARIETY USED	TOTAL SOLIDS <i>per cent</i>	WEIGHT OF MIL- LABLE STALKS OF EACH STOOL <i>kgm.</i>	AVERAGE HEIGHT OF STALKS OF EACH STOOL <i>cm.</i>	AVERAGE DIAMETER OF STALK OF EACH STOOL <i>cm.</i>	AVERAGE LENGTH OF INTERNODE OF STALK OF EACH STOOL <i>cm.</i>	NUMBER OF MIL- LABLE STALKS OF EACH STOOL	NUMBER OF UN- MILLABLE STALKS OF EACH STOOL
P. B. 119	17.4361 ± .0729	2.9620 ± .0554	.8561 ± .0317	3.5672 ± .0696	7.6176 ± .0734	3.5588 ± .0619	2.9444 ± .0798
C. A. C. 87	11.4228 ± .0929	2.3071 ± .0945	1.4714 ± .0314	2.0857 ± .0284	15.6428 ± .0611	6.3213 ± .1169	10.2857 ± .6063
(P.B. 119 × C.A.C. 87)F ₁	13.8146 ± .0178	3.2814 ± .0447	.8406 ± .0062	3.3848 ± .0091	8.5765 ± .0550	5.1789 ± .0510	2.1425 ± .0422
P. B. 119 naturally selfed	14.2621 ± .0706	3.1166 ± .0645	1.0644 ± .0113	3.0552 ± .0119	10.4989 ± .7731	5.5080 ± .0912	2.0803 ± .0566

DISCUSSION OF RESULTS

There was a wide range of variation in the percentage of total solids in both the supposed (P. B. 119 × C. A. C. 87) F_1 hybrid and P. B. 119 naturally-selfed seedlings; the total solids content, ranged from 2.91 per cent to 28.16 per cent, with a mean of 13.8146 ± 0.0178 per cent. The P. B. 119 naturally-selfed seedlings showed a range from 2.91 per cent to 25.13 per cent, with a mean of 14.2621 ± 0.0706 per cent. It will be observed from these figures that the hybrids had a wider class range with respect to the percentage of total solids than the naturally-selfed seedlings of P. B. 119. However, the standard deviation and the coefficient of variability for this character were higher in the P. B. 119 natural seedlings than in the hybrids.



Fig. 3.—(P. B. 119 × C. A. C. 87) F_1 hybrid seedlings showing variability in color. (1) Hybrid seedling No. 2371 similar to P. B. 119. (2) Hybrid seedling No. 2369 similar to C. A. C. 87. Selected.

The percentage of total solids in the hybrids was found to lie between the values exhibited by the parents. The hybrids had a higher percentage of total solids (mean 13.8146 ± 0.0178 per cent) than the male parent (11.428 ± 0.0929 per cent in table 3), but lower than the female parent (17.436 ± 0.0729 per cent in table 3). It is interesting to note in this connection that invariably the seedlings of both groups, having only one or two short stalks in a stool, had an exceedingly high percentage of total solids.

The (P. B. 119 × C. A. C. 87) F_1 hybrid seedlings had a wider range both in class value and in variability constants with regard to tonnage or weight of millable stalks than the naturally-selfed seedlings. The range of variability for the (P. B. 119 × C. A. C. 87) F_1 hybrid seedlings was from 0.45 kilogram to 18.05 kilograms, and the P. B. 119 naturally-selfed seedlings, 0.45 kilogram to 14.85 kilograms. The variability constants (standard deviation and coefficient of variability) in the hybrid are higher than those in the P. B. 119 naturally-selfed seedlings. These were found to be 2.5267 ± 0.0316 kilograms and 77.0006 ± 1.4254 per cent for the hybrid and 2.1372 ± 0.0456 kilograms and 68.5747 ± 2.0414 per cent for the naturally-selfed seedlings. They had practically the same means, 3.2814 ± 0.0447 kilograms for the hybrids and 3.1166 ± 0.0645 kilograms for the naturally-selfed seedlings.

It may be remarked that such characters, as number of millable stalks, diameter of stalks, and height of stalks are contributive to the variation in weight of millable stalks.

Both classes of seedlings have practically the same height of millable stalks, the mode, or the typical height being 0.95 meter in both cases. The mean values are 0.8406 ± 0.0062 meter for (P. B. 119 × C. A. C. 87)F₁ hybrid and 1.0644 ± 0.0113 meters for the P. B. 119 naturally-selfed seedlings. The height of millable stalks, as a character, however, had a greater coefficient of variability value in the hybrid than in the case of the naturally-selfed seedlings. These values were 42.0533 ± 0.6125 per cent in the hybrid and 35.2405 ± 0.8415 per cent in the naturally-selfed seedlings.

The hybrid seedlings again had a higher degree of variability with regard to diameter of stalk than the naturally-selfed seedlings. The mean diameter of the millable stalk of the hybrid was 3.3848 ± 0.0091 cm. as compared with 3.0552 ± 0.0119 cm. for the millable stalk of the P. B. 119 naturally-selfed seedlings. The variability constants were all greater in the hybrid than in the naturally-selfed seedlings. With regard to this character, it may be stated that the typical stalks of the hybrid seedlings measured not less than 3.3 cm. in diameter. The diameter of the stalk was found to be one of the agronomical characters, improvement of which over the male parent was partially attained by crossing. The male parent (C. A. C. 87) had a mean diameter of 2.0857 ± 0.0284 cm. (table 3), while the female parent had 3.5672 ± 0.0696 cm.

While the two groups of seedlings had the same range of variation in the average length of internodes of millable stalks, the hybrid seedlings exhibited a greater standard deviation and coefficient of variability than the naturally-selfed seedlings. The hybrid seedlings gave a standard deviation of 3.1071 ± 0.0389 cm. and a coefficient of variability of 36.2280 ± 0.5096 per cent. The naturally-selfed seedlings, on the other hand, had a standard deviation of 2.5581 ± 0.5467 cm. and a coefficient of variability of 24.3654 ± 0.5507 per cent. The mean length of the internode of the hybrid was 8.5765 ± 0.0550 cm., of the naturally-selfed seedlings, 10.4989 ± 0.7731



Fig. 4.—Naturally-selfed seedlings of P. B. 119 showing variability in number of stalks. (1) Seedling No. 2674. (2) Seedling No. 2643.

cm. It is interesting to note at this juncture that the hybrid seedlings had a greater diameter of stalk (3.3848 ± 0.0091 cm.) and a shorter internode (8.5765 ± 0.0550 cm.) than the male parent (C. A. C. 87) with stalk diameter of 2.0857 ± 0.0284 cm. and internode of 15.6428 ± 0.0611 cm. but exhibited a thinner stalk and longer internode than the female parent (P. B. 119) with stalk diameter of 3.5672 ± 0.0696 cm. and internode of 7.6176 ± 0.0734 cm. (See table 3.)

Upon examination of the data on the number of stalks both millable and unmillable, it was seen that the wider range of variation was again found to be in favor of the hybrids. The number of millable stalks in the hybrid ranged from 1.5 to 25.5 stalks and in the naturally-selfed seedlings, from 1.5 to 17.5 stalks; the unmillable stalks in the hybrid seedlings ranged from 1.5 to 11.5, and in the naturally-selfed seedlings from 1.5 to 7.5. The means for the number of both millable and unmillable stalks in both the hybrid and the naturally-selfed seedlings were practically the same. The hybrid seedlings were found to have a mean number of 5.1789 ± 0.0510 millable stalks and 2.1425 ± 0.0422 unmillable stalks. The naturally-selfed seedlings were found to have a mean number of 5.5080 ± 0.0912 millable stalks and 2.0803 ± 0.0566 unmillable stalks. Using the coefficient of variability as an index of variation it will be found that the characters in question were, in all cases, more variable in the hybrids than in the naturally-selfed seedlings.

It was seen that in both groups of seedlings there were more close stools than open ones. With regard to growth habit, the hybrids had more erect plants than reclining and lodging. In the naturally-selfed plants, however, there were more reclining plants than erect and lodging. An outstanding feature observed in these seedlings was the presence of a great number of erect or semi-erect plants among the hybrids. The occurrence of a minimum number of lodging plants was also an encouraging aspect in this study. In color of stalks, the purple plants predominated over the rosy and the flesh-colored ones. This seems to point out that a greater proportion of the hybrids had acquired the color of their male parent. In both kinds of seedlings, the plants with upright leaves were more abundant than those with bending leaves. There was a greater number of plants with hairy leaves than semi-smooth ones. With respect to the presence of hairs on the leaves, it may be mentioned that the female parent (P. B. 119) is more hairy than the male parent (C. A. C. 87). The prominence of buds in the majority of the seedlings of both classes was also a significant feature, as canes with prominent buds are a good class of planting material.

TABLE 2

Summary of the data on the diseases observed on the seedlings

SEEDLINGS USED	DISEASE FREE	FIJI	MOZAIC	LEAF SPOT			
				Very slightly	Slightly	Badly	Very badly
(P. B. 119 × C. A. C. 87) F_1 ...	5	5	46	30	715	566	61
P. B. 119 naturally selfed.	0	1	12	2	400	71	13

Referring to table 2 it may be seen that leaf spot was more prevalent than the serious diseases, Fiji and mosaic. Five apparently absolutely disease-free plants were found in the hybrids, but none in the naturally-selfed seedlings. It should be recalled at this point that the hybrid seedlings were derived from a supposedly disease resistant male parent and a rather disease-susceptible female parent.

Table 3 is a summary of the important agronomical characters exhibited by both the parents and the hybrids. The figures listed are the means for the percentages of total solids, height of stalk, diameter of main stalk, length of internode, number of millable stalks and number of unmillable stalks. The data of the male parent, C. A. C. 87, and the female parent, P. B. 119, were computed from a smaller number of individuals than those of the hybrid and naturally-selfed seedlings. It is evident, from the figures in table 3, that the mean characteristic of the hybrid seedlings was in all cases located within the limits of the two parents. For instance, with regard to the percentage of total solids, the (P. B. 119 × C. A. C. 87) F_1 hybrids had a mean value of 13.8146 ± 0.0178 per cent while the male parent (C. A. C. 87) had 11.4228 ± 0.0929 per cent and the female parent (P. B. 119) had 14.4361 ± 0.0729 per cent. Likewise, in all other characters, such as the height of stalk, diameter of stalk, length of internode, number of millable stalks and number of unmillable stalks, the mean values for the hybrids lie between those of the parents. Except in the height of millable stalks, the hybrid seedlings exhibited the other agronomical characters in a more or less improved state.



Fig. 5.—(P. B. 119 × C. A. C. 87) F_1 hybrid seedling No. 2331 selected for its size.

TABLE 4

Comparative data from the 1925-1926 selected seedlings and their respective asexual offspring

SEED- LING NUMBER	PERCENTAGE OF TOTAL SOLIDS		WEIGHT OF MILLABLE STALKS		HEIGHT OF STALK OF EACH STOOL		DIAMETER OF STALK OF EACH STOOL		NUMBER OF MILLABLE STALKS IN EACH STOOL		NUMBER OF UNMILLABLE STALKS IN EACH STOOL	
	Sexual parent ^a	Asex- ual off- spring ^b	Sex- ual par- ent	Asex- ual off- spring	Sex- ual par- ent	Asex- ual off- spring	Sex- ual par- ent	Asex- ual off- spring	Sex- ual par- ent	Asex- ual off- spring	Sex- ual par- ent	Asex- ual off- spring
			<i>kgm.</i>	<i>kgm.</i>	<i>m.</i>	<i>m.</i>	<i>cm.</i>	<i>cm.</i>				
P.B. 151	21.036	12.320	3.2	4.80	2.25	1.61	2.45	3.24	3	7.60	4	3.60
P.B. 152	18.254	16.745	2.8	2.53	2.04	1.37	2.37	3.11	4	2.00	3	1.75
P.B. 153	20.354	16.126	3.3	3.25	2.50	1.70	2.08	2.78	5	6.16	5	7.00
P.B. 155	21.890	10.789	3.0	7.40	1.56	1.37	2.72	3.00	5	11.00	7	3.00
P.B. 156	21.470	12.846	2.6	4.01	1.36	1.74	2.62	3.78	5	3.83	3	2.50
P.B. 157	23.538	14.863	2.3	3.56	2.14	1.10	3.70	3.81	3	3.25	3	1.62
P.B. 158	20.958	16.304	2.2	3.65	1.71	1.05	2.66	3.16	3	4.86	1	1.63
P.B. 159	21.024	17.955	3.2	3.48	1.66	.95	2.40	3.46	6	4.80	2	2.20
P.B. 160	20.778	18.503	2.8	3.63	2.73	1.14	3.15	4.13	4	3.66	2	1.60

^aData for the sexual parents were compiled from Florida's thesis (1926).^bThese data, which represent averages, were gathered by the writer.

Table 4 gives the comparative descriptions of the 1925-1926 selected seedlings as sexual parents and their respective 1926-1927 asexual offspring. The figures under the sexual parents are original determinations, when they were isolated during the 1925-1926 season. The data on the asexual offspring were obtained by the writer during the present experiment and represent averages for the characters studied. It was found that the asexual offspring had a relatively low percentage of total solids, as compared with that of their asexual parents. The same condition was observed also in the case of the height of the main stalk. However, the tonnage or the weight of millable stalks, the diameter of stalks, and the number of both millable and unmillable stalks, were greater in the offspring than in the parents—a condition which may explain the decrease in the percentage of total solids. For, as has been mentioned elsewhere in this paper, the cane plants with a very few stalks generally had high content of total solids. The marked increase in tonnage shown by the asexual offspring may be explained by the corresponding increase in the number and diameter of stalks.

In attempting to make the foregoing comparison, it must be borne in mind that the different agronomical characters were represented by one determination in the sexual parent and an average of a number of determinations on the asexual offspring. Moreover, no check was planted with the asexual offspring. For this reason, it was thought unwise to interpret the differences observed between the sexual parents and their asexual off-

spring with respect to these agronomical characters, in the light of probable error concept.

The selection of seedlings was made immediately after the observations on the different agronomical characters for each of the seedlings were completed. The selection was made by studying the mean values for the percentage of total solids, weight of stalks, height of stalks, diameter of stalks, length of internodes, number of millable and unmillable stalks and disease infestation of both the hybrid and naturally-selved seedlings. In selecting the seedlings, special emphasis was given to the tonnage, height of stalks, number of stalks, and freedom from disease. All seedlings affected with mosaic were eliminated, but those slightly affected with leaf spots were retained. A certain allowance was given in the case of the percentage of total solids, that is, a seedling which had a percentage of total solids a little below the average, was selected if it excelled in other agronomical characters. Generally, the seedlings which had values, on or above the average of the different characters mentioned, were all selected. From among 1500 hybrid seedlings, 224 plants were isolated. Fifty-nine seedlings were selected from about 500 of the naturally-selved plants of P. B. 119. All of these selected seedlings were turned over to the Division of Plant Breeding for subsequent observations.



Fig. 6.—(P. B. 119 $\times$ C. A. C. 87) F_1 hybrid seedling No. 2438 which is similar to P. B. 119 in color and characteristics of the rind, but resembles C. A. C. 87 in all other respects. Selected.

SUMMARY OF CONCLUSIONS

1. The hybrid seedlings involved in this study were first generation offspring of a cross between P. B. 119 as a female parent and C. A. C. 87, as a male parent. Hybridization was undertaken in an effort to combine in the hybrid plants such characters as thick stalk and high sucrose content from the female parent and long stalk and disease resistance from the male parent.

2. A high degree of variability in the percentage of total solids, weight of stalks, average height of stalks, average diameter of stalks, length of internodes, and number of millable and unmillable stalks, was observed among the hybrid and naturally-selved seedlings. The range of variation

of these characters, was, in all instances, found wider in the hybrids than in the naturally-selfed seedlings.

3. Several characters of agronomical importance were apparently improved as a result of crossing; among these are tonnage, more erect stalks, number of stalks, and percentage of total solids. The P. B. 119 naturally-selfed seedlings gave a lower percentage of total solids than the parent, but excelled it in tonnage, height of stalks, length of internode, and number of millable stalks.

4. Some apparently disease-free plants appeared among the hybrids, but none among the naturally-selfed seedlings.

5. The asexual offspring of the 1925-1926 selected seedlings were found to be superior to the parent plants as to tonnage of cane, average diameter of stalks, and number of millable and unmillable stalks.

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GREAT FARMERS

The greatest Americans have been farmers and it is tragic for the school histories and rural school specialists to allow children to think of these men in other capacities with no reference to their leadership in agriculture.

Benjamin Franklin is glorified for many achievements but never a hint that he made a great contribution to successful farming. He was the pioneer in chemical fertilizing which transformed American gardening and later American farming. When Franklin represented the United States in France, which led the world in successful gardening, he was greatly interested in the fact that plaster was universally used by successful gardeners. Philadelphia was the center of progressive gardening in the New World and Franklin had a cargo of plaster brought across the Atlantic. But it did not sell promptly and so in front of the place where it was for sale he wrote on the lawn in plaster, *Plaster-of-Paris*. He meant simply to tell where it came from, but it has been called "Plaster of Paris" a hundred and twenty-five years and will be so called for another hundred and twenty-five years. Benjamin Franklin gave of his time, talent and money to promote the use of chemical fertilizers and every country boy and girl in America should appreciate it.

Hereford cattle are raised largely in every state in the Union. There are now several million of these white-faced cattle in the United States, but they are relatively a new feature of beef cattle in this country. Henry Clay was the greatest political orator America has known. He had the most intense following. He was the idol of many of the best people in the United States. Recently the city of Richmond, Indiana, erected a monument in honor of Henry Clay on the spot where he stood when he made a political speech there.

But Henry Clay's real monument is the white face steer which can be seen in every county in the United States. He was a great farmer. At Lexington, Kentucky, his farm which he called "Ashland," was the most famous farm in the New World eighty-five years ago, and the greatest attraction there were the Hereford cattle which he imported. The first white face cattle to cross the Atlantic were for "Ashland". Why not have country boys and girls feel a thrill of pride when they see and talk of Herefords?

Duroc Jerseys are now the most numerous swine in America. There are millions of these farm animals in the country but they are not here accidentally. They did not come spontaneously. They came to meet an emergency. Farmers have always been subject to live stock fanaticisms and it centered in swine eighty-five years ago. One group of farmers shouted

for black hogs and another for white hogs. The feeling was intense. Those who championed white hogs said that black attracted the sun and was liable to burn the skin. Then Daniel Webster, the greatest statesman-orator America has had, joined other peacemakers, compromisers, for he was the most famous political compromiser in the country, and imported red swine—neither black nor white—and today the Duroc Jerseys are the most numerous breed of swine in America.

Why not let country children have a bit of pride when they see Duroc Jerseys, knowing that Webster whose orations have been in school readers for seventy-five years, imported red swine from Spain?

Thomas Jefferson, the writer of the Declaration of Independence, the most famous president from Washington to Lincoln, was the most famous farmer except Washington until the civil war. Monticello, Charlottesville, Virginia, is Mount Vernon's only farm rival in historic interest. Jefferson made this residence and farm even more important in detailed perfection than Mount Vernon though it has not the location that Washington's residence has and it is not accessible to Washington and to patriotic tourists as Mount Vernon is. Monticello has been recently purchased by patriotic citizens and is to be a perpetual memorial to President Jefferson.

John Jay, the first justice of the United States Supreme Court, one of the leading American lawyers a century and a half ago, the writer of some of the greatest treaties between the United States and Great Britain, and the most famous governor New York state has had, devoted the last thirty years of his life to the promotion of scientific gardening in Westchester county, New York. He raised the best garden crops in the best way and introduced new varieties, of fruits, melons and vegetables and induced the produce dealers of New York to make a market for them. After thirty years in eminent statesmanship he spent thirty years in making farm life happier and more profitable.

It was George Washington, the father of his country, who was also the father of American farming and made Virginia, the mother of presidents, also the mother of farmers. A hundred and fifty years ago he established rotation of farm crops, was the first to breed better horses, better cattle and better sheep. Washington divided his estate on the Potomac into five farms with a masterful farmer in charge of each and no farm could raise any staple crop more than once in five years, no two farms could raise the same crop any year so that he had practically the same amount of each product every year and every farm rotated crops on a five-year schedule.

Washington was the first American to keep several high-quality stallions to improve his own stock and the stock of farms thereabouts. At the close of the Revolutionary war he bought from the government the young crippled mares and bred them to these high-grade stallions. He killed off the lambs that were not extra good and bred only the best sheep until he claimed that his sheep sheared five pounds of wool each more than any other

sheep. Perhaps Washington's greatest live stock service to America was the introduction of the mule industry. Pioneering in the southwest had a great boom and Washington himself invested in land in Missouri. He insisted that pioneering could not be profitable with oxen. They were too slow, nor with horses for they were too sensitive to weather conditions, to food and care. He said mules were indifferent to weather, care, and food. But mules were impossible without jacks and jacks were few, good jacks were wholly lacking in the United States. Spain and southern France had a monopoly of jacks, but Spain would allow none to be exported and France discouraged exportation. However, the king of Spain, an admirer of Washington, sent him the best young jack in his country and Lafayette sent him six likely jacks. Washington sent these jacks for service in the south and southwest, establishing an industry that now gives to America nine million mules, mostly of high grade.—A. E. WINSHIP. *Successful Farming* (Iowa).

“Never you mind the crowd, lad, nor fancy your life won't tell;
The work is done for all that, to him that doeth it well.
Fancy the world a hill, lad, look where the millions stop.
You'll find the crowds at the base, lad, but there's always room at the top.
Courage and faith and patience; there is space in the old world yet;
You stand a better chance, lad, the further along you get.
The road may be rough and rocky, but never despair nor drop;
Be sure your path leads upward, there's always room at the top.”

Every piece of work which is not as good as you can make it, in which you have palmed off imperfect, meagerly thought, niggardly in execution, upon mankind, every hasty or slovenly performance should rise up against you in the court of your own heart and condemn you for a thief.—R. L. STEVENSON.

When tillage begins other arts follow. The farmers therefore are the founders of human civilization.—DANIEL WEBSTER.

EXTENSION DIVISION NOTES

The Need of Diversification in the Philippines

The Philippines though comprising 49 provinces may be divided into only a few crop regions, as the rice, the sugar, the abaca, the coconut, the tobacco, etc. In many provinces only one or two major crops and very little if any of the other crops are grown. There are provinces where rice alone is raised and others that produce only coconut or tobacco. In very few provinces could the crops be called sufficiently diversified for commercial purposes. As a result of this practice any abnormalities in the trend of prices of a Philippine crop vitally affects the regions in which that crop is raised. A sort of crisis often occurs in the regions.

For instance, if the price of sugar becomes abnormally low the people of Negros become distressed. If the price of tobacco falls it is the people of Isabela and Cagayan who suffer most. If the price of abaca moves downward the people of the abaca-growing regions are alarmed. Sometimes the government has to intervene to help the people, as recently was true in the rice region. The price of rice became lower than usual and the people at once demanded that the rice ban which has been in effect since 1919 be lifted. The pressure of this demand became so great that the Governor General declared the ban lifted for four months effective November 1, 1927. This was done in spite of opposition from some regions. These conditions of Philippine agriculture indicate that our crop industries are not yet very stable institutions.

We know that fluctuations in crop prices will occur because they are affected by changes in the world's supply and demand. We cannot control the price of any of our crops because all, except abaca, have foreign competitors and the prices are affected by the world markets. This is the natural course in the agricultural world and if we are to contribute to markets we must learn to compete. Our survival in competition is the index of the stability of our crop industries. In cases of economic disturbance which affects our country we must make our adjustments within. To safeguard our local economic interests at such times we must adopt preventive measures. One method of prevention is to practice diversification of crops to some degree. If this were done to a degree not detrimental to the main crop of the diversified system fluctuations in crop prices could be tided over until prices become normal.

Let us cite Batangas province as an example. The sole industry in this province is agriculture including several of our export crops; but it suffers little from fluctuations of crop prices. This is because diversified farming is practiced to a greater extent, probably, than in any other province

in the Islands. Also it is one of the very few provinces in which both live stock and farm crops seem to be raised in fair proportions.

The live stock industry in Batangas is perhaps one of the best if not the best representatives of an old development in the Islands. Here is produced the largest number of quality race horses. According to Mr. Valentin K. Lina's findings in the records of the Manila Jockey Club, "Batangas, Camarines provinces, Cebu, Cavite, Negros provinces, Misamis, Pampanga, and Bulacan, lead in supplying the Manila Jockey Club with race horses. Batangas registers about four times the number originating from Camarines provinces which rank second." They are nationally famous. Its work bullocks are no less renowned in local markets for their good conformation, endurance, strength, and hardiness. Hogs and chickens of Batangas, as commercially produced, are also of the best quality.

The province ranks first in coffee production, although the day of its glory when the exports of one town amounted to ₱4,000,000 annually is past. Batangas leads in the production of Mandarin, being the only province that produces this fruit in commercial quantities, and the quality is considered the best in the Islands. The province ranks third in cane sugar production, and has two modern sugar centrals. It is fast becoming a coconut region. Some towns have planted large areas of land comparable in size to plantations in towns of old coconut areas. The production of Bolbok, a coconut town of Batangas, is said to be almost equal that of Candelaria, a coconut district of Tayabas, and it is accepted that the production of Lipa, another coconut town, is more than the production of Alaminos, a coconut town of Laguna. The coconut plantations in the province are still on the increase, hundreds of hectares are being converted into coconut plantations every year. Besides these major crops the people raise tropical fruits of several kinds in fairly large quantities, and enough rice is produced for its own population. It also produces enough corn for the subsistence of its farm animals.

With this degree of diversification with a few major crop industries the agricultural status of Batangas seems to rest on a fairly stable basis. The people are never greatly worried by abrupt fluctuations in crop prices. Provinces the conditions of which warrant diversified farming should practice it as it is the safest way to insure a stable agriculture. If diversification can be practiced so as not to be detrimental to the major crop in so small a province as Batangas there is no reason why it cannot be practiced in other regions. Of recent years several provinces have been striving to follow the example of Batangas. Pangasinan, which formerly was a rice region, is now converting some of its rice fields to sugar cane, coconut, and mango plantations. A sugar central is to be erected in the province in the near future. Tarlac, another rice province, is increasing its sugar cane fields and a sugar central has recently been established in the province. We hope other provinces will follow suit.

One important reason why diversification should be practiced in the Philippines is that it can lessen the number of idle days of the Philippine farmer. It has been found that one of the causes of the poor financial condition of the Philippine farmers is that they are jobless so much of the time. Most of them practice the one crop system and after that crop is harvested they are idle as there is nothing more to do on the farm. If diversification were practiced they can find work almost throughout the year and their earning capacity will be materially increased. In some instances where the land cannot be cultivated in certain months of the year owing to dryness of the soil, idleness on the farm may be excusable. However, the raising of a few farm animals will help them a great deal. There are places in the Philippines where cultivation is possible throughout most of the whole year. In such places diversification can readily be practiced and idle days on the farm could be greatly reduced. In the present state of agricultural conditions in the Philippines there is a great need of diversification and it should be practiced where conditions permit.

Problems in Reviving the Coffee Industry of Lipa, Batangas

The revival of the coffee industry of Lipa, Batangas, is at present the hopeful speculation of many interested in coffee culture. That there is a strong tendency to replant the crop is quite true. The government is giving all the necessary aid to revive the industry. But in spite of the aid of the government and the enthusiasm of the people there are vital problems which make the revival not as fast as hoped. Very few, if any, wide and solid plantations are being started. Many are planting coffee, but they are planting it on a very limited scale and at a very slow rate.

The existing conditions in Lipa today explains why this is so. They are very different from when the coffee industry was developed years ago. In those times large *haciendas* were common in Lipa, and the land belonged to only a few families of the town. The farms, that is the coffee plantations, were all managed by administration. *Hacenderos* counted their servants by the hundreds. In those times labor was very cheap and the land owners had plenty of money so that they could easily afford to employ workers on wage basis. Since the downfall of the coffee industry in Lipa about 1890 the great majority of the large *haciendas* of Lipa have been continually broken up into small lots. The system of farm management has been changed from the administration system to the *kasama* system (share arrangement).

In starting coffee plantations, especially on a large scale, it is very necessary that it be managed by administration. Plenty of capital is needed and one must have other sources of income besides the land he is planting with coffee, because he will have no income from this for at least four years. In the first year he will plant nothing but the future shade trees of the coffee and prepare the seed. After planting the coffee at the

end of the first year he will have to wait for three or four years, depending upon the variety that he plants, before he gets any income from coffee. And during this time of waiting he will have to spend money for maintenance and upkeep. With these requirements it is very hard for a man with limited land and income to start a large plantation.

The conditions of the farmers in Lipa at present are such that it is impossible for them to open large plantations. Their farms are managed by the inexpensive *kasama* system. As we all know, the management of a farm under the *kasama* system involves the division of the produce between landlord and *kasama*. But land planted to coffee cannot be planted with another crop. This type of farming cannot be done under the *kasama* system. The *kasama* cannot wait for three or four years without income. And when the coffee bears fruit the sharing of the produce as under the *kasama* system cannot be made.

At present few people of Lipa can afford to run their farms by administration. The majority do not have sufficient land and capital to spare. So they plant coffee only in small patches such as they can spare every year. In many cases, purposely, no shade trees for coffee are planted. Lots that had been once a *kaingin* in which a second growth forest is growing are planted to coffee. In this way the farmers spend nothing for shade trees, thus saving a considerable sum of money and effort. This is of course not a very good method but it is decidedly the cheapest and one that they can easily afford. Such are the problems being met by the Lipeños in reviving their coffee industry.

Personal Inquiry from Guam on the College Copra Drier

Representatives of large plantation owners from the island of Guam came to the College Campus purposely to see for themselves how the Roxas-Henares copra drier is actually built. They had read the description in the College Circular No. 11. The gentlemen were Mr. Margarito Palting, Mr. José M. Torres and Mr. F. Iturzaeta. The first two are the sons of two wealthy coconut landowners in Guam, Attorney P. R. Palting and Mr. Francisco Calvo Torres, and the third is Mr. Torres' agent in Manila. These men were especially sent here to inspect the drier. They had read of the test of the efficiency of the drier made some time ago on the College Farm.

The visitors were welcomed by Acting Dean Gonzales and conducted to the place where the driers were erected and are being repaired from damages wrought by the typhoon last year. Dr. Vicente Aldaba, specialist in coconut, showed them part by part the construction of the drier and the manner in which it is operated. These men have been seeking a type of copra drier that would produce a superior quality of copra and at the same time a device small and simple and economical enough for small farmers to handle without difficulty. Their large plantations in Guam are divided

into rather small units, each unit being tended by a common farmer who does everything; planting, keeping, harvesting and making the nuts into copra. They are satisfied with their present system of a management and they do not want to change it. They desire to keep the farmer attached to his small farm unit. But they want to enable their tenants to produce a better quality of copra under the existing conditions by placing in their hands a suitable copra drier that can be run by them.

After a careful inspection of the machine, the visitors appeared satisfied that the College of Agriculture copra drier fully answers their purpose. Their idea is to introduce on their plantations for their tenants a drier like the smaller unit of the College Copra Driers shown them.

EXCHANGE NOTES

Gas ripened tomatoes were sold on the Minneapolis and St. Paul markets this season. These tomatoes were grown by local truck gardeners, picked when mature but before they began to turn, given the gas treatment three to five days and delivered to consumers. The process was tried repeatedly under laboratory methods before it was undertaken by farmers with crude equipment. Under both sets of conditions it was effective.....

"The gas ripened tomatoes are not distinguishable from those ripened in the field," said Mr. Stassen, "except that they have no green area around the stem. In the market no one could tell the difference, except perhaps for the uniform red color. I do not believe anybody could detect a difference in taste."

—*Capper's Farmer* (Kansas).

Male birds need not be kept, unless the breeding of chickens is desired. The fact that there is no male in the pen will have absolutely no effect on the number of eggs laid by the hens. A pen of six Black Orpington pullets at the Burnley Egg-laying Competition have just made an official record for winter egg production by laying 643 eggs in 122 days, ending 31st July, and no male birds are allowed with the pullets at the competition.

—*Journal of Agriculture* (Victoria).

The slow development of the primary industries of the State has for some time caused concern among those closely in touch with rural affairs. Australia is but a young country and the wealth of its soil is the first that should be exploited. Instead, however, we are confronted with very slight advances in the total quantity of primary products and an almost imperceptible increase in rural population. Unfortunately, even the young people brought up on the farms are being attracted away to city avenues

of employment, and the first effort to solve the problem must therefore be an endeavour to convince them that rural life is the pleasantest and the most profitable. As to the first of these conditions, ordinary social development is daily removing the disabilities that once attached to farm and station life, but the impression that the occupations of the country are as attractive financially as those of the city can only be achieved by inculcating sound methods of production.

With the view to making a beginning in this direction several organizations are combining in New South Wales to promote the formation of junior clubs for boys and girls in every district with the object of promoting competitions which will cultivate a liking for rural pursuits and arouse interest in their great possibilities. The many characters these competitions can take are obvious—some have already been conducted in this and other countries but their value in discreet hands cannot be doubted.

—*The Agricultural Gazette* (New South Wales).

The soy bean can now be grown successfully in any climate suitable to corn or cotton. The principal uses of the soy bean are for hay, pasture, silage, grain, oil and oil meal, and human food. With such a wide range of uses the production of the soy bean is no longer localized and its increasing importance is assured.

—*Cultivator* (California).

A butterfly "farm" is operated by Mrs. F. W. Casterline of Tipton, Iowa, on her screened porch. While she operates it primarily as a hobby she finds it a considerable source of income as well.

—*The Prairie Farmer* (Illinois).

During the year the Ministry of Finance (North Ireland) laid plans whereby the Ministry of Agriculture may grant loans to farmers for the purchase of bulls, agricultural machinery, erection of silos, minor land improvements, and erection of small structures. Short-time loans to replace livestock lost during the previous winter were also approved.

In general the plans provide for loans not to exceed 75 per cent of the cost, and fix a maximum and minimum that may be loaned, require the bull, machinery, or structure to be approved by the ministry, and require repayment in equal installments extending to 2 years for bulls, 3 years for machinery, 5 years for improvements, to 10 to 20 years for silos. Interest charges are fixed at from 5 to 5½ per cent. The regulations for loans for purchasing machinery, equipment, and bulls are set forth in detail.

—*Experiment Station Record* (U. S. Dept. Agric.).

Soy beans should be cut for hay soon after the seed pods have been formed and before the seeds have been fully developed, about the time the lower leaves begin to turn yellow and drop.

For seed soys should be allowed to become fully matured before harvesting. At this time the leaves will have largely dropped off. If they stand up well it is more satisfactory to cut and bind and shock them and let them stand in the shocks until dry enough to thresh. They may be cut with a mower and shocked until ready to thresh, but more of the seed will shatter and be lost and they will be harder to thresh.

In making hay of soys they should be allowed to become well wilted in the swath before raking and shocking, but should not be allowed to become dry enough to shatter off the leaves. The shocks will shed water better if put up when the hay is a little green.

—*Prairie Farmer* (Illinois).

Baked Bananas With Honey

- 6 bananas
- 2 tablespoons butter
- 2 tablespoons honey
- 2 tablespoons lemon juice

Remove skins and cut in halves lengthwise. Arrange in a shallow granite pan or platter. Spread the honey over the bananas, dot with butter and pour on the lemon juice. Bake 20 minutes in a slow oven, and baste occasionally with sauce.

—*Prairie Farmer* (Illinois).

COLLEGE AND ALUMNI NOTES

Mr. Tabat of the Bureau of Forestry and Mr. H. Atherton Lee of the Sugar Centrals Agency were recent visitors at the Division of Plant Breeding of the Agronomy Department. Mr. Tabat is in charge of the planting of *Cinchona* plants in Bukidnon. He spoke highly of the possibilities of quinine culture in Bukidnon. He looked over the seedlings of *Cinchona Ledgeriana* and *C. succirubra* being grown by the Department from seeds obtained personally by Doctor Mendiola from the *Cinchona* Experiment Station at Tjinjirean, Java. Mr. Tabat is planning to take a course in rubber budding under Doctor Mendiola next College year. He secured from the division seeds of the cover crop, *Calopogonium muconoides* for trial in Bukidnon.

Mr. Lee visited the sugar cane breeding work being done by the department and received assurance of full co-operation by the Plant Breeding staff.

Prof. and Mrs. John Bentley, Jr., of Cornell University, were Campus guests for a few days recently. The Cornellians on the Campus entertained Professor and Mrs. Bentley at an All-Cornellian dinner at the residence of Doctor and Mrs. Tubangui. An evening of bridge at Doctor and Mrs. Mendiola's residence followed the dinner.

The Cornellians on the Campus are:

Forest School, P. Franco '22; College of Veterinary Science, A. K. Gomez '18, M. A. Tubangui '21; College of Agriculture, N. B. Mendiola '18, F. M. Fronda '20, A. Gordon '25, R. Moreno '25, F. T. Adriano '27, L. G. Gonzalez '27.

WHAT ADVICE SHALL WE GIVE TO OUR GRADUATES?

It would seem that, regardless of the nature of the curricula, the main job of an agricultural college is to give students a real university training, comparable to that given by any department in a university: so that regardless of whether or not they pursue agriculture upon graduation they can think independently, and will become real students of the work they undertake.

University graduates in agriculture, and also graduates of other colleges will and do return to the soil, and engage in farming, if they like agriculture and have sufficient capital to farm in such a way as to give them an adequate living. But why stir up the undergraduates and recent graduates to a desire which in too many cases leads to disappointment? Why not give them a good university training in their chosen field, and wish them well in any field of endeavor they may choose to follow.

Through agriculture, students can be well and broadly educated. We need more leadership, more business in farming, less subsidy and paternalism. Let us make our curricula conducive to independence, good citizenship, and clear thinking. We know the graduates will have agriculture at heart, and when capital and opportunity permit, coupled with a desire to engage in agriculture, they will return to the soil.—THOMAS TAVERNETTI, *Assistant to Dean, College of Agriculture, University of California.*

—Quarterly of Alpha Zeta

DOES AN AGRICULTURAL COLLEGE EDUCATION UNFIT A MAN FOR FARMING?

Such lines of work as teaching, extension work, and a number of others, require men who have been college trained, so that groups who do not go back to the farm are pursuing professional work which is very necessary, and for which only they are fitted.

More and more, agricultural colleges are fitting in the practical side of agriculture with book learning. Consequently, the old familiar argument that college "just gives a man book learning and nothing else," must be passed into discard along with such theories as planting potatoes by the sign of the moon. Not only does college give a man the practical side of farming from the standpoint of management and cultural practices, but it teaches the principles of economics, a little psychology and many other

sciences which one has to know something about in order to keep abreast of the ever increasing knowledge of other classes of people. . . .

When one has a basis such as this, why should he not be able to become a farm leader? The argument will be advanced that all this education, together with the social advantages which are such a necessary part of college, have caused him to lose interest in the farm life, with its long hours of hard work. Perhaps this may be the case with some. If so, well and good, because they are better off away from the farm, and the number included in this group is not so great compared to the total farming population. If these people have minds adapted and trained for research or are particularly adept in teaching or extension work, they will do more for the farms than by settling down somewhere and actually running a farm. So long as a fair percentage of the college graduates return to the farm, there is no cause for worry. The writer has yet to see a man who after completing an agricultural college course has returned to the farm who has not made good, although there are doubtless some.

There is one main reason why students do not return to the farm at once after completing college. They do not have a suitable farm available and do not wish to embark in farming without capital, so they enter other lines of work. Many of them eventually go back to the farm as soon as they have accumulated sufficient for a proper start.

—*Quarterly of Alpha Zeta*

RE THE FINANCIAL CONDITION OF THE TAO LET US LOOK IN THE HORSE'S MOUTH!

"Many years ago in Italy, when the convents of the Middle Ages were the repositories of human knowledge, a party of monks were arguing about the number of teeth in the mouth of the horse. Arguments were many and heated, numerous musty old tomes were opened, and references to authority frequent and conflicting. Finally one clever young monk—and what a brilliant mind to conceive it—suggested that they all go out and LOOK IN THE MOUTH OF THE HORSE! Here was the first exponent of the "case method of investigation"—the only truly scientific method—and a man to whom a monument should have been erected."

There are near 10,000,000 of the tao class in the Philippines. They represent the great majority of the Filipino people. All with first hand knowledge of the subject agree that their economic condition is an unsafe one, and a constant and growing danger to the whole economic structure of this country and people. Agrarian problems now press upon us. Many remedies have been suggested and some tried without general success. Much talk has been had and many opinions have been expressed. *Only two or three isolated efforts have been made to actually "look in the horse's mouth!"*

We press the fundamental importance of a comprehensive detailed survey of the whole question, by men *thoroughly equipped* for investigation in *agricultural economics* and pray that this may be actively set under way at the earliest possible date.—CHARLES FULLER BAKER.

CATTLE RAISING UNDER PHILIPPINE CONDITIONS¹

VALENTE VILLEGAS

Of the Department of Animal Husbandry

REVISED BY B. M. GONZALEZ

WITH SIX TEXT FIGURES

There is at present great interest in the Philippines in cattle raising, and with the improvement of marketing facilities and a consequent betterment of prices many more people may be expected to engage in the industry. The operation of a cattle ranch is comparatively simple, and reasonable profits may be confidently expected from investment put into such a business, but the ranchman must put his knowledge into actual use at all times to insure success. As a number of enterprising beginners who do not possess the necessary training and experience in the work are lured into cattle raising, this article was prepared with the hope of helping them in their early efforts.

SELECTION OF SITE

Cattle raising can be carried out best in places where large tracts of cheap land are available, as in sparsely populated and in hilly and mountainous regions. Such areas are usually low in fertility or otherwise unfit for intensive crop farming. The area should be fairly high, well-drained, and traversed by one or more small streams or rivers to serve as natural watering places. If streams are absent, provision should be made for the watering of the stock artificially by means of wells and pumps. It is possible in some places to dig deeper natural drainage ponds where water tends to collect and utilize these as watering places.

On the whole, however, an area without a steady water supply cannot be considered as a good location for a cattle ranch. A more or less uniform distribution of rainfall is desirable and very important in maintaining a regular supply of pasturage, which should consist of palatable and productive grass species. Too much rainfall, however, during the colder months of the year is prejudicial to the health and well-being of the animals.

SIZE OF INITIAL HERD

For a beginner who intends to raise cattle under range conditions, an initial herd of not less than 50 breeding cows is recommended. With more

¹Experiment Station contribution No. 514. Received for publication November 29, 1927.

capital one may start on a herd of 100. There is an advantage in starting on a small scale, as the rancher is enabled to acquire knowledge and experience with a greater chance of success and less of loss, since his problems are relatively simpler if his herd is small. It is not wise to start with fewer than fifty animals. A smaller herd does not warrant a man's devoting his full time to the enterprise and the business probably will be conducted in a haphazard manner, resulting in loss rather than in profit.

KINDS OF STOCK

The exclusive use of the usual run of native animals for the production of market cattle generally gives poor results, as native animals are as a rule too small. Highly selected native cows may be expected to produce superior animals and these may be used as the foundation of the herd. The Nellore cattle of India have acquitted themselves most satisfactorily in improving the native animals under Philippine conditions, and good bulls of this breed may be used to mate with the native cows.

The use of Nellore bulls on native cows produces larger animals than the native, more active, harder in constitution and to a certain extent more resistant to rinderpest, foot-and-mouth disease, and ticks. But if more than half Nellore blood is allowed in the grades certain undesirable qualities manifest themselves, such as viciousness, intractability, legginess, and narrowness of body. To counteract these tendencies a low-set, stocky, and docile type of cattle should be employed. Bulls from beef breeds such as the Hereford, Shorthorn, and Galloway may be used to counteract the defects imparted by the Indian breed, but they are not as hardy as the Indians and this defect is equally transmitted to the offspring.

SELECTION OF BULL

The bull makes up one-half of the blood composition of its progeny in a herd, but in practice a well selected sire, because of his superiority, exerts a greater and more marked influence in improving the quality of his offspring. Therefore, it is very important that the right type of bull be chosen for the herd.

The Philippine market demands a good-sized animal that will be useful for either beef or for work, or an animal that can be used for work first then butchered afterwards for beef. Briefly, an animal of this type should be big, low-set, well-muscled, tractable, active, and strong. Native bullocks from Batangas Province and half-blood Nellore-Native steers will usually classify under this group.

Nellore bulls are often narrow, upstanding, spare, and leggy. Animals that are extreme in these characteristics should be discriminated against. The weight should not be less than 500 kilograms at maturity. Gray or white color is preferred. The characteristics of the animal should be markedly masculine. The testicles should be well-developed and well let down.

The head should show ruggedness, and the neck, shoulders, and hump should be thick and muscular. Prominence and good development of the hump give evidence of masculinity. The bull should be active and aggressive. All these features indicate good breeding ability, necessary for the production of uniform, superior offspring.

If native or grade bulls are to be used, they should be not less than 400 kilograms in weight. The color should be solid of any shade.

SELECTION OF COWS

Less stringent rules may apply in the selection of cows. But to disregard their merits and depend wholly on the superiority of the bull to correct

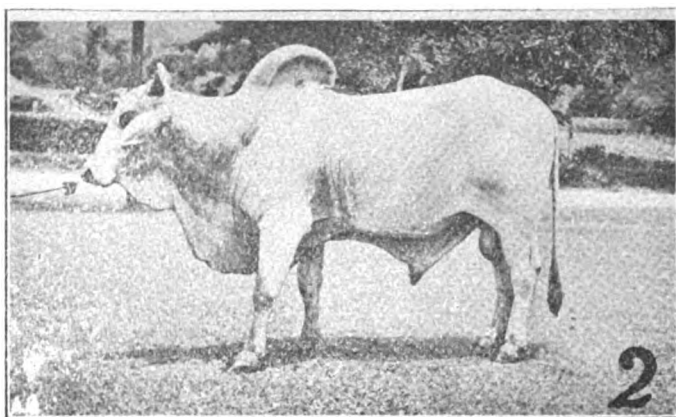


Fig. 1.—A pure-bred Nellore bull possessing depth and roundness of body suitable for grading up native cattle. Note masculinity shown by ruggedness of head, prominence of hump and hanging dewlap.

Weight 591 kilograms, height 140 centimeters.

all deficiencies in conformation and other characteristics is fallacious. The dam contributes as much blood as the sire in the composition of the progeny.

The use of native animals as foundation cows is economical and practicable, as they are available at nominal prices. Another advantage in using native cows is that they are prolific and fairly well adapted to local conditions. However, because of promiscuous breeding among them, their size and conformation is oftentimes very poor. To build up a herd of good quality, cows weighing less than 250 kilograms should not be used for breeding.

Besides good conformation, the development and instincts of the cow should be taken into consideration. These should be typical of her sex. Together with strong constitution as shown in the good development of chest and barrel, the hindquarters should be wide, deep, long, and level,

features that are conducive to the normal delivery of well-formed fetus. The udders and teats should be of large size. The cow should have a mild maternal face, for such animals generally tend their calves well.

Heifers from two to six years old should be selected in order that their period of usefulness may be longer. Whenever possible, heifers with calves or in calf should be secured, as this constitutes a guarantee of fertility and affords an opportunity to observe the ability of the dam to raise its young. In exceptional cases, old cows which are known to produce regularly good offspring may be purchased for breeding purposes. Calves from such cows are likely to inherit the good performance of their dams.

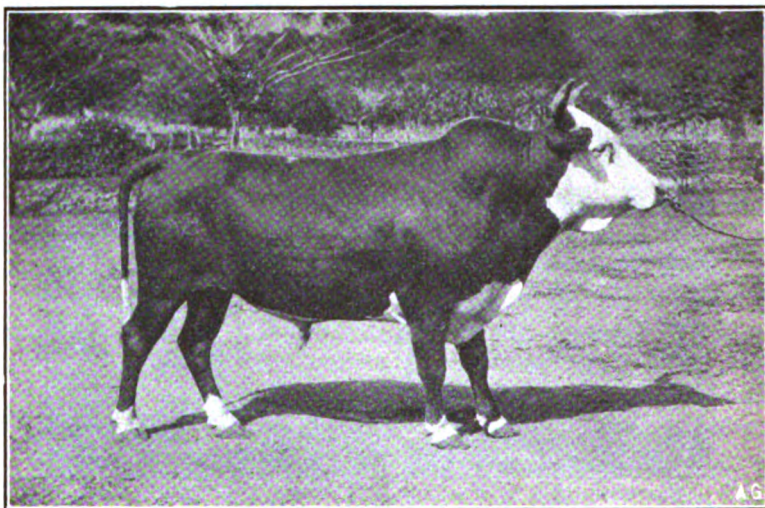


Fig. 2.—A grade Hereford bull. Low in stature but wide, deep, long, and meaty. Because of the Hereford blood early maturity, blockiness and meatiness may be transmitted to its offspring.

Weight 440 kilograms, height 125 centimeters.

HERD MANAGEMENT

For the best results, cattle on a large ranch may be divided into four main herds, as follows:

1. Breeding herd
2. Pure-bred herd
3. Heifer herd
4. Bull and steer herd

Breeding herd. This herd consists of breeding cows, bulls, and calves. Dry cows and cows with calves should be kept in this herd. The calves should be allowed to remain up to about six months of age or a little over, before they are weaned out. Breeding bulls are placed in this herd at the rate of one bull for every 25 to 30 cows. This being the largest herd, the animals should be placed in the best and most extensive pasture.

The herd should receive careful and close supervision on account of the calves, both the newly born and the others. The herdsman should make daily inspection of the herd. When a new calf is born it should be caught and the ear notched to indicate the year in which it is calved. Records of the sex and color of the calf and brand number of the dam should be recorded. Calves that are born weak, especially during bad weather, should be taken with the mother to the barn and kept under shelter until they are strong enough to stand conditions in the open pasture. Sometimes the raw navel of a newborn calf will be infested with maggots. In such cases the calf and dam should be taken to the barn for treatment. Calves that are disowned by their dams, or orphaned, may be raised by hand on other cow's milk.

At the taking of inventory, which is done at least once a year during the time of castration and branding, cows whose calving records show that they have failed to produce for two years or over should be eliminated from the herd and sold as butcher stock. Normally, range cows are expected to calve once a year. If the highest breeding efficiency of the herd is to be attained, animals that are abnormally defective in appearance, cows that habitually abandon their calves or disown them, and dams that repeatedly abort or produce dead or weak calves should be disposed of. A breeding efficiency of 75 per cent, that is, to produce 75 calves out of 100 breeding cows, is considered a high standard. Such bulls in the herd as are old and inactive breeders or are naturally passive and indifferent should be castrated and sold for slaughter.

Pure-bred herd. The purpose of the pure-bred herd is to supply the ranch with the necessary bulls to be used in the breeding herd to produce market animals. The maintenance of this herd is warranted only on large ranches where the demand for breeding bulls is great. Besides being more economical to produce pure-bred bulls in the same ranch, it is far more satisfactory to produce them according to the rancher's own ideals of breeding. On a small ranch, pure-bred cows may be kept and mixed in the breeding herd to produce pure-bred bulls for the ranch. Surplus pure-bred bulls that are produced beyond the number needed by the ranch, or individuals that are discarded because of certain defects, may be disposed of as market animals.

Heifer herd. At weaning time, when calves of about six or eight months of age are separated from their dams, the heifers should be placed in a separate pasture. These animals should be allowed to grow unbred to the age of one and one-half to two years when they should be transferred to the breeding herd. The separation of these heifers from the breeding herd, while entailing extra expense in fencing and herdsman's time, pays through the uninterrupted development of the animals. It is common knowledge that heifers bred very early become stunted and are likely not to reach the full development they would if breeding were delayed.

Heifers should be placed in a strong-fenced pasture far from other herds. If close to the breeding or pure-bred herd the weanlings are likely to break through the fence seeking their mothers. If placed close to the bull herd the bulls are apt to break through the fence and breed the heifers.

Steer and bull herd. The steers may be mixed with either the bull herds or the heifer herds. It is, however, advisable that the steers be placed with the bulls so as to form a fair-sized herd. Usually if steers are mixed with heifers the herd becomes unreasonably large. There is also uniformity in the appearance of a herd when bulls and steers are placed together. Furthermore, in practice it is difficult to distinguish between

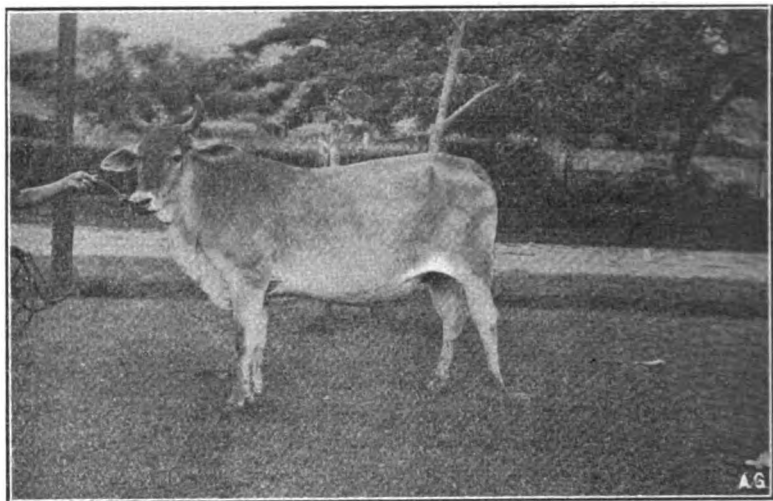


Fig. 3.—A grade Nellore cow of desirable type. Tall and long, yet with deep and round body.

Weight 344 kilograms, height 122 centimeters.

weanling castrates and entires and when steers are separated from the bulls and placed with the heifer herd some bulls are likely to be put in the herd.

From the steer and bull herd, market animals are obtained. These may be breeding bulls, work stock or slaughter steers. The herd serves also to grow breeding bulls for the ranch. To get the maximum service from these bulls, they should not be used until they are about three years of age. Work and slaughter steers attain marketable weight between three and four years of age. Breeding bulls for sale are in greater demand when they are young when the price is relatively low.

Bulls that do not sell because of poor type, conformation, size or other defects should be castrated and sold as work animals or for slaughter.

The market value of work steers is augmented about 20 per cent if they are broken to work. It will pay to employ extra men, if necessary, to train them. They may be trained both for the plow and cart.

Cattle, particularly butcher stock, are best marketed on the basis of weight. For this reason it is very important that ranches be equipped with stock scales. Pit scales are recommended for large establishments; they are possibly more durable although more expensive than the pitless kind. On small ranches a portable scale with a weighing capacity of 300 kilograms or over may be employed. The total weight of the animal is obtained by adding the weight of the front to that of the hind legs of the animal. The animal should stand level, and for this purpose a platform should be provided of exactly the same height as the weighing floor of the scale. Animals that are fairly docile may be weighed in this manner.

QUARANTINE PASTURE

An isolated pasture, far from any of the main herds, should be set aside for quarantining sick as well as newly purchased animals. A shed may be constructed in this pasture. All animals on the ranch that contract infectious diseases should be confined in this pasture. Likewise, new stock from outside should first be quarantined here before they are mixed with the main herds. The period of quarantine should be about one month and animals that show no symptom of disease at the end of that period may be pronounced healthy.

SALTING

Common salt is necessary for the proper utilization of the feed and for other bodily needs. Animals failing to get an adequate supply of this mineral are restless, out of condition, and develop a rough coat of hair. About one kilogram of salt daily may be allowed for every 100 head of cattle. It may be given at inspection time by pouring on dry ground and distributing it at different spots to prevent overcrowding. The herdsman will do well to adopt a call—as “asin” (salt)—to bring the animals together at one place at salting time. The animals soon learn to respond and rush to the place where the herdsman is. By enticing the animals to lick salt from one’s hand they become tame and approachable.

RECORDING OF BIRTHS

One of the important items of routine work in cattle management is the recording of births. By making this record, the actual production of the ranch and the breeding efficiency of the cows are known. The age and sex of calves born are also obtained.

The practice of recording births followed on Diklom Ranch, Bukidnon, may be suggested: The herdsman is equipped with a pair of scissors when he goes out to inspect the herds. New births, recognized by the absence of marks, are caught and the ears slit according to the year in which they were born. For example, a slit on the tip of the right ear may be taken for 1927 births. Different marks may be adopted for other years, depending on the

position on the ear and whether it is right or the left. At weaning time the abbreviated figures for the year, as "27" for "1927", is branded on the arm of the animal. This serves as a guide in telling the age of the animal at first glance, when they are marketed or for other purposes.

A disadvantage in leaving calves unmarked in a large herd is that such calves may be recorded at different dates as new births, thereby making the numbers of animals inaccurate in the herd. Also, wrong dams of older unmarked calves may be recorded, as older calves roam a great deal, some of them remaining close to cows other than their mothers which may be taken as their dams. Some cows even allow outside calves to suckle from them.

In a small herd the calves may be marked to indicate their herd numbers; these are afterwards branded either back of the thigh or on the arm. For this purpose an ear notcher is necessary. The diagram shown in figure 4 is recommended; it shows the corresponding numbers pertaining to the

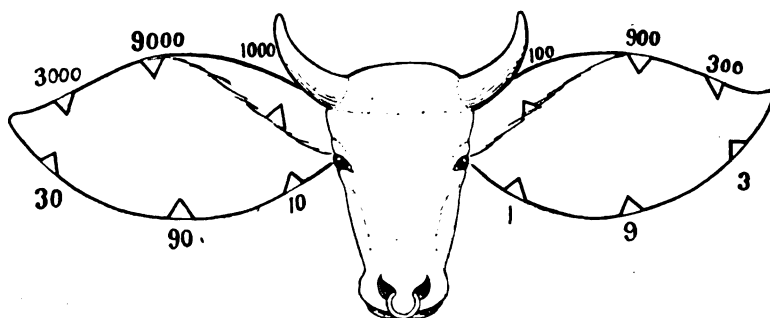


Fig. 4.—Diagram showing numbering of notches on ears.

notches possible on both ears of the animal. By combining a number of notches, any number may be produced.

WEANING

Calves are weaned at the age of six to eight months. By this time they are so mature that they can be separated from their dams without injury to their health and condition. Also, by this time the udders are beginning to dry up so the cows suffer no injury when the calves are separated from them.

It is important that weaning be done in due time; otherwise, the young bulls will begin to breed. Young heifers are also likely to be bred at a very early age. Besides, delay in weaning these calves means increased difficulties in separating and catching them, and in branding and castrating.

Weanlings are separated from their dams outright and placed in a corral made with a tight and strong fence, preferably of woven wire. Barbed wire for fencing weaning corrals is objectionable inasmuch as it is likely to cause injury to fretful and restless calves seeking their mothers during

the early period of weaning. The calves should be placed in the corral for about 15 to 20 days; at the end of this period they will have forgotten their dams and may be placed in the herds to which they properly belong.

Simultaneous with the weaning operation all calves are branded and the males which are not wanted for breeding should be castrated.

Castration. There should be on the ranch one emasculator, one scalpel or pocket knife, or even more, creoline, pine tar, and cosmoline. A piece of rag or cotton is necessary to cleanse and swab the scrotum before and after the operation. Several lariats are needed for catching and casting the animals.

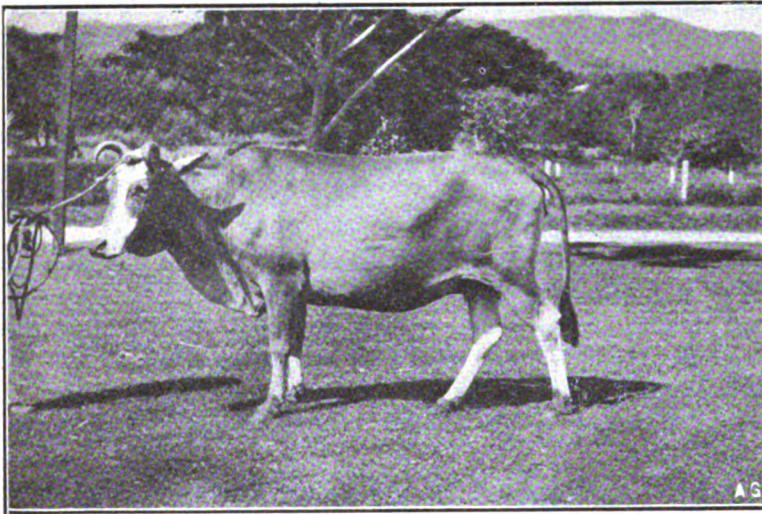


Fig. 5.—A choice cow of native breeding. Of good size, symmetry, and constitution.

Weight 318 kilograms, height 112 centimeters.

Range animals are caught by the head with the lasso and thrown down by pulling on the rope placed around the hind legs. On large ranches cowboys on well-trained ponies are used to facilitate the work of catching and casting. When the animal is cast it may be held in place by one man holding down the head and another seating himself behind the hindquarters so that the upper hindleg is held and stretched backward and the under hindleg pushed forward by one of the man's legs. Large and strong weanlings which cannot be subjected to this method of restraint are hogtied; that is, the four legs are tied together, before they are castrated.

Proper disinfection with creoline solution should be made before and after the operation. Calves with testicles small and undeveloped that are castrated young may be unsexed without the use of the emasculator. With a knife the scrotum is cut through including the inner membrane, and the

testicles are squeezed out. These are pulled out and the spermatic cord is torn off with the fingers. The end of the scrotum may also be capped out and the inner membrane cut through before the testicles are removed. Then the calf is turned loose. During fly season a mixture of pine tar and vaseline should be applied on the wound as fly repellent. If the spermatic cord is well developed the emasculator should be used in severing the cord. It should be held for a while before releasing it so the edges of the spermatic cord may be crushed and the blood allowed to clot and thus prevent profuse bleeding.

Branding. During the castration operation the weanlings may be branded. The law requires two brands: the municipality brand placed on the right hip and the owner's brand on the left hip. On well-managed ranches two other brands are recommended; namely, serial numbers on one of the arms indicating the year in which the animal was born and herd numbers branded on the hind part of the thigh.

Copper, although expensive, is the best material for branding irons as it retains heat for a long time and does not rust. However, iron branding irons serve the purpose satisfactorily enough and may last long if allowed to cool gradually after use and if kept oiled while in storage. The parts of the branding irons may be 5 millimeters thick and 14 millimeters deep. A height of 10 centimeters for letter brands and 7 centimeters for numbers give good results. Avoid sharp corners on brands by rounding them or disconnecting. Owner's brand should be simple and plain, so that a clear-cut, legible imprint is left on the skin of the animal after branding. Cumbersome and intricate brands produce blurred figures and burn the hide unnecessarily.

Good results are obtained by heating the brands red hot before application. The hide must be scorched before removing the iron. Wet or soiled skin must be cleaned and dried before branding. No medicine should be applied on the brand as otherwise it will heal clean and leave a very obscure mark.

Cattle may be rounded up for weaning, castration, branding, and inventory any time from January to May of each year. Climatic conditions at this time are more favorable to carry on all-day work and for the healing of wounds resulting from castration and branding. This season is also free from flies which are always a menace to the proper recovery of castrated and branded animals. Calves weaned in this season thrive better than during the rainy season provided enough grass is available in the pastures where they are kept.

COMMON AILMENTS

Only minor troubles affecting cattle will be discussed in this paper. Also, only remedies which have proved most practical and economical are indicated.

Navel infection. On the range, navel infection is common during damp weather. During fly time navel wounds may be seen unduly swollen and infected on account of the maggots infesting the tissues. Calves affected with this infection stamp on the ground with their feet. They are also restless and irritable if the sore is aggravated and large. To prevent serious cases of navel infection, calves found so infected should be caught at once and the navel disinfected and painted with tincture of iodine. With an advanced case, both mother and calf should be caught and taken to the barn. Here the calf should be thrown down and the maggots removed by killing with drops of creoline and picking them out with pincers afterwards. The wound may then be disinfected and dusted with calomel regularly until dry.

Wounds and scratches. From various causes, as goring one another, injuries caused by hard objects in the pasture, etc., wounds and scratches are very common in a herd. Such injuries if neglected may become infected, and turn into chronic suppurating sores. Mr. Florentino Cruz, Superintendent of the Nellore Ranch, in Bukidnon, employs a method of preventing infection which gives satisfactory results. The herdsman on his daily rounds with the herds carries a pole at the end of which is attached a swab soaked in pine tar. Any scratch or wound found on an animal is painted with pine tar. This keeps the flies off and disinfects the wound so that no injury becomes serious and healing takes place readily. In the case of chronic sores or large wounds the animal is caught and taken to the barn and placed in a stock or cast and the dead tissues of the wound cut off. The wound is then cleaned and disinfected and calomel or iodoform applied. This treatment may be repeated regularly until the wound is completely healed.

Eye sores. Eye sores may be caused by fly bites or result from physical injury. They are shown by swollen and watery eyes. Any neglect may lead to infection and blindness. The animal should be taken to the barn and placed in a stock and the head held firmly in place and the eyes cleaned with boric acid solution. A little calomel in a funnel of paper is then blown directly into the eyes.

Ear sores. Flies like to feed on the excretions inside the ears of cattle and during fly season the bites made may be so general that the sores become a suitable medium for maggots to feed on. Infection usually takes place and a foul odor is produced. If not attended to in due time the sore may implicate the deeper tissues and form an abscess which may turn chronic and suppurating. The animal affected should be placed in a stock and the wound irrigated and cleaned thoroughly with disinfectant and the maggots removed. Then calomel or iodoform should be dusted on the sore and pine tar painted on the outside to drive off flies.

Warts. Warts may develop on animals on the range and besides making them look unsightly may annoy them. When only a few small outgrowths are present they may be removed by cauterizing with caustics. Large warts are pared off with a knife and the wounds burnt with caustic.

Weak calves. Mothers poor in constitution or ill-nourished and old cows may produce weak offspring. During the stormy and wet season of the year some calves do not stand unfavorable conditions and therefore weaken. Then there are a few cows that do not produce enough milk for their calves, so they become stunted and unhealthy. Different calves require special treatment, but as a rule they thrive better if placed under shelter and given additional feed. Very young calves will improve on additional milk from other cows while older calves will fatten on cracked corn and rice bran.

Orphaned calves may be raised successfully. A calf is first taught to drink milk from a pail by coaxing it to suck one's finger, and then lowering it in a pail containing milk. Once taught to drink from a pail the danger

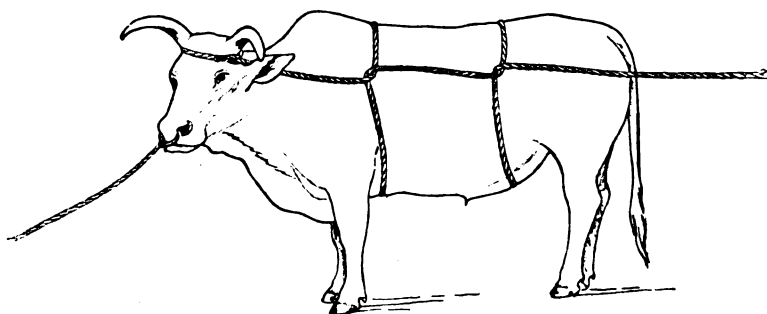


Fig. 6.—Device for throwing down a steer.

lies in overfeeding the calf. As a rule, three to five kilograms of milk daily is sufficient. Feeding may be done three times a day until the calf is three weeks old, after which it may be reduced to two times daily. As soon as the calf is about two months old a mixture of cracked corn and rice bran may be given in such amounts as it will consume readily each feeding. At about four months of age, milk feeding may be gradually eliminated. Fine palatable grass should be placed before the calves all the time as soon as they will take it.

PASTURE MANAGEMENT

The ranch may be divided into as many or more pastures as there are herds. Ranching in regions of limited extension may be regulated by allotting two or three pastures for each herd for rotation purposes. Greater efficiency of the pastures are obtained in this way besides the chance of the pastures becoming infested with parasites and disease is reduced.

Cogon (*Imperata cylindrica* Linn.), bagochoc (*Andropogon nitidus* (Vahl) Kunth) are the most abundant range grasses in different regions of

the Islands. Other grasses that are found in abundance include talahib (*Saccharum spontaneum* Linn.), aguiñgay (*Rottboelia exaltata* Linn. f), aguiñgay babae (*Andropogon halepensis* var. *propinquus* Kunth), carabao grass (*Paspalum conjugatum* Berg.), and amor seco (*Andropogon aciculatus* Retz.). All these grasses are suitable cattle feed although cogon and talahib require burning over or mowing before cattle relish the new shoots.

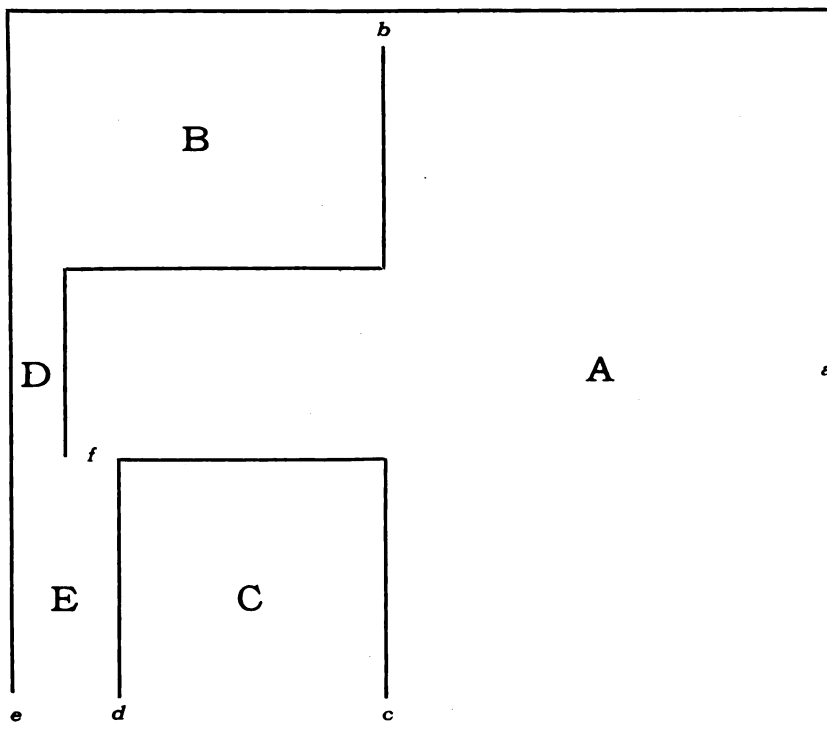


Fig. 7.—Diagram of a separating corral. How to use: Let us suppose that some steers are wanted for sale. The herd is driven through door *a* into corral *A*. If the herd is small all animals may be driven into corral *B* through door *b*. One by one the animals are driven through chute *D*. Steers that are wanted are driven into corral *C* by first closing doors *e* and *f* and opening door *d*. Any other animal may be driven out into the pasture through door *e*. On the other hand, if an animal other than steers is wanted for some reason, for example, a diseased animal which requires treatment, it may be driven back into corral *A* through door *f*.

The scale for weighing purposes is placed at the middle of chute *D*.

The growing of carabao grass should be encouraged. It is productive and palatable. It is easily propagated by seed and thrives best on moist slopes and under trees.

Of the foreign grasses, Natal grass (*Tricholaena rosea* Nees) adapts itself well on pastures and spreads rapidly from the seeds blown by the winds. The grass is readily eaten by different classes of animals, although it is not very productive.

On ranges which suffer from drought, the shortage of forage supply may be obviated by storing grass hay during seasons of abundance. A mowing machine drawn by work bullocks may be used in cutting grass.

In dividing the ranch into sections, wooded hills, mountains, and rivers may be used as boundaries or partitions between pastures. No fences are necessary in such cases and a great saving is effected. Strong and satisfactory fences can be made with three barbed wires nailed on posts three meters apart. Ipil-ipil (*Leucaena glauca* (Linn.) Benth.), anonang (*Cordia dichotoma* Forst. f.), madre de cacao (*Gliricidia sepium* (Jacq.) Stend.), and bamboo butts may be used as posts. These posts are cut two meters long and are placed in the ground 60 centimeters deep. The lowest wire is placed 35 centimeters above the ground, the highest 1.40 meters, and the middle strand closer to the lower wire than to the upper. To construct 100 meters of barbed wire fence using ipil-ipil or similar posts will cost, under Los Baños conditions, approximately twelve pesos. Such a fence may last for one and a half years with little repair. Madre de cacao posts if set during the rainy season take root readily and may extend the life of the fence considerably.

Catching and weaning corrals require a strong and smooth fence. For these, woven wire, 47 inches high, is used. The posts are set at the same distance and depth as with barbed wire fence. Using wooden posts, the cost of putting up 100 meters of this fence, under Los Baños conditions, is approximately 39 pesos.

The carrying capacity of the pastures may be estimated at a maximum rate of one animal to the hectare. Such a maximum may be possible in fertile grasslands with regular rains and the vegetation maintained properly by rotation, well-regulated grazing, and weeding. The animals should be allowed to graze close enough to increase the growth of more young shoots and yet not so close as to permit weeds to gain headway and crowd the grass. With poorer pastures, greater areas will be necessary to maintain an ox throughout the year, much depending on the climate of the region and availability and productivity of pasturage. In practice it is best to allow but one-half the number of cattle which may normally be carried by the ranch throughout the year. Weeds should be cut before flowering time to reduce further multiplication. Overmature and fibrous grass may be cut with a mowing machine and on hilly places where the mower can not be used properly the herbage may be burned over. Burn or mow only such areas as are needed by the animals at a time. Small woodlots on well-drained portions of the pastures are important to protect the animals from the sun's heat at midday and to provide shelter during inclement weather. On very open pastures, however, it may be necessary to build strong sheds for protection of the animals.

As many watering places as possible on a range are conducive to good health of cattle and proper utilization of the pastures. On a level open

plain, watering sites should be not more than eight kilometers apart, whereas on hilly and rougher areas the distance should be about one and one-half kilometers. Clean, pure water is essential for the well-being of cattle and with streams the source should be regularly inspected to see that there is no contamination to endanger the health of the animals on the ranch.

The gathering of cattle at night in a corral is not necessary, except for purposes of guarding them against thieves.

KEEPING OF RECORDS

The importance of keeping records of each animal on the ranch cannot be overestimated. Where there are 200 head or less, records of each animal may be taken as to herd number, sex, date calved, parentage, description (mainly as to color) and manner of disposal. With cows, the dates of calvings are also recorded to determine the performance of each animal. On larger ranches a more simple system of recording is advisable. Only the herd number, sex, approximate age and manner of disposal are important, except in the case of cows, for which the dates of calving are necessary. A permanent file of cards for recording purposes from which various data for the benefit of the ranch may be obtained is advocated.

VETERINARY SUPPLY

A list of instruments needed on a ranch is as follows:

- 1 clinical thermometer for temperature reading
- 1 scalpel for minor surgical operations, castration, etc.
- 1 pair of shears for trimming wounds and cutting purposes
- 1 artery forceps for stopping hemorrhage
- 1 emasculator for castration
- 1 fountain syringe for administration of enema
- 1 metal syringe for flushing wounds, drenching, and rectal injection
- 1 trocar and cannula for bloat and for ringing of bulls
- Assorted curved needles and surgical thread for suturing purposes

Among the chemical preparations that are commonly used for medical purposes are the following:

- Creoline for general disinfection purposes
- Lysol or carbolic acid for special disinfection
- Vaseline and coconut oil as vehicle for other medicine
- Raw linseed oil, Epsom salts and Glauber's salts for purgative
- Calomel or iodoform for wounds; calomel is used also for eyesores
- Tincture of iodine for wounds
- Tannic acid, alum for astringent
- Boric acid for eye wash
- Ethyl alcohol for various purposes

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THE SEED AND OIL OF *JATROPHA CURCAS*¹

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WITH ONE TEXT FIGURE

INTRODUCTION

Jatropha curcas is a native of Tropical America, but it is now acclimatized and widely distributed throughout the Philippine Islands, being commonly cultivated as support for fences in urban districts of the Archipelago. It belongs to the family Euphorbiaceae. The plant is locally known as *tubang bakud* (Tagalog) or *tauataua* (Ilocano). From different countries *Jatropha* has been reported to grow rapidly and equally well in a great variety of soils and to produce an abundance of nuts which are used in a great variety of ways. In the Philippine Islands, oil is extracted from the seed by rendering and the oil thereby obtained is used for illumination. Gamble (1902) reported that in India the oil extracted from the seeds is used for illumination, and for medicine as purgative and emetic; also that the seeds are sometimes collected and sold, and that the leaves are used for feeding silk worms when there are no mulberry leaves. In the Philippine Islands it is very well known that when the seeds of *Jatropha* are eaten they act as quite a powerful purgative. Klein (1898) reports that in Tropical America and in all Portuguese colonies, chiefly in Cape Verde Island, the plant is cultivated for its fruit. He states that in Réunion the plant is cultivated as a support for the vanilla plant.

Lewkowitsch (1903) reported that the seeds consist of 66 per cent of kernels and 34 per cent of husks. The kernels yield, on extraction with ether, 52.0 per cent of oil or 34.3 per cent on the basis of the whole seed. He further states that on exposure to the air the oil changes from a pale color to yellow with reddish tints, and that 100 parts of absolute alcohol dissolve 2.17 volumes of the oil at 15.5°C. Klein (1898) found, however, that alcohol, whose purity is not mentioned, dissolved 2.41 parts of the oil, and that the oil yielded about 10 per cent of solid fatty acids. Lewkowitsch (1903) also made mention of the report of an investigator by the name of Bouis who claimed there was isocetic acid in the oil. Lewkowitsch expressed grave doubts as to Bouis' findings. The mixed fatty acids have not been studied and the exact proportions of the acids present in the oil have not been mentioned. All in all the work on purging nut oil is still very meagre.

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The present investigation was undertaken to determine: (a) the percentage of oil in the seed; (b) the physical properties of the oil; (c) the chemical properties of the oil; (d) the composition of the oil; and (e) the composition of the seed cake and pulp.

PREPARATION OF THE OIL

The seeds used in this investigation were obtained from the provinces of Ilocos Sur, Ilocos Norte, Cagayan, and Batangas. The samples from those provinces were air dried. The first step in the process was the removal of the fruit pulp from the seeds; the seeds were then shelled and the kernels passed through a meat grinder. It was found that the fruit is composed of 58.12 per cent kernels and 42.88 per cent shells.

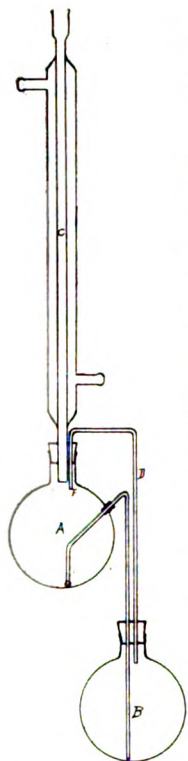


Fig. 1.—A modified Soxhlet apparatus.

The oil from a small portion of the ground kernels was extracted with ether in the Soxhlet extractor. It gave an average yield of 51.89 per cent of oil or 22.23 per cent of the whole seed. The remainder of the ground nut was placed in flask A (see fig. 1) and the oil was extracted with chloroform until practically all was removed. In the figure, C is an ordinary Liebig condenser, B and A are balloon flasks in which a bore is made in A about two-thirds from the bottom of the flask. B contains the initial solvent for extraction. The liquid in B is brought to boiling and the vapor of the solvent passes through D and comes in contact with the sample where the tubing enters A. Any volatilized solvent goes up to the condenser and is thereby condensed and brought back to A. The condensed solvent with the dissolved oil is automatically syphoned to B and the process is continued until the solvent accumulating at A before it is syphoned back to B is practically colorless, showing the absence of any appreciable amount of oil dissolved in it. The solvent at B is distilled off in order to recover the solvent used and to free the oil from the solvent. The last traces of the solvent in the oil is removed by passing steam through the oil and the mixture is allowed to stand in a separatory funnel and the water layer drawn off. The moist oil is now mixed with anhydrous sodium sulfate at

ordinary temperature and the mixture resulting thereof allowed to stand for at least 48 hours in the desk. The oil is then filtered off and the oil thus obtained which is light yellow is the sample of oil used in this investigation.

PHYSICAL PROPERTIES OF THE OIL

The oil is clear and in a thin layer has a very light yellow tint, and when in a layer of moderate thickness is light yellow. It is not disagreeable to the taste nor as to odor.

The specific gravity of the oil, determined by the pycnometer, was found to be 0.9141, at 27.5°C. The index of refraction by means of the Abbe refractometer was 1.4698 at 30.9°C. The melting points are -8° to -9° and the solidifying points -9° to -10°C. These figures show that the oil at ordinary temperatures is liquid.

CHEMICAL PROPERTIES OF THE OIL

Chemical characteristics

The chemical and physical characteristics given in the following tabulation represent the averages of several determinations. These were determined for the purpose of ascertaining the general composition of the oil, as well as to furnish a basis of comparison with other oils. For purposes of direct comparison the chemical and physical constants of *Ricinus communis* oil and *Croton tiglium* oil are here included.

	<i>Jatropha curcas</i>	<i>Ricinus communis</i> ^a	<i>Croton tiglium</i> ^a
Specific gravity.....	0.9141	0.9591	0.9437
Refractive index.....	1.4698	1.4795 to 1.4803	1.4781
Solidifying point °C.	-8° to -10°	-10° to -12°	-7°
Melting point °C.	-8° to -9°		
Saponification value.....	195.89	176.7 to 186.6	192.9 to 215.6
Iodine number (Hanus).....	101.8	81.4 to 90.6	101.7 to 109.1
Hydroxyl value.....	2.15		
Acetyl value.....	2.16	149.9 to 150.5	19.82 to 32.66 ^b
Acid number.....	10.2		
Unsaponifiable matter.....	0.5		0.55 ^b

^a William H. Brown. 1921. Minor products of Philippine forests. Philippine Bureau of Forestry Bulletin. 22 (vol. 2): 1-410. Fig. 1-157.

^b M. A. Rakusin. 1906. Über das verhalten der wichtigsten pflanzenole gegen das polarisierte lichte. Chem. Zeit. p. 143.

It is evident that the oil of *Jatropha curcas* is not of the same type as that of castor oil but is more like that of the oil of *Croton tiglium*. The data show that it contains a very little amount of soluble or volatile fatty acids and a very little amount of hydroxylated acids, the hydroxyl value being 2.15 per cent and the saponification number 195.89 mgm. It contains very little unsaponifiable matter, only 0.5 per cent.

*Separation of the saturated fatty acids from the unsaturated fatty acids
in the neutral oil*

The resolution of the neutral oil into the saturated and unsaturated fatty acids was effected by the same principle as that of the lead-salt-ether method of Gusserow (1828) and of Varrentrapp (1903); the method followed by the writer (1924) in a previous investigation of this kind being adopted. This method involves the conversion of the acids into their lead salts, which in the case of the saturated acids are insoluble in dry ethyl ether, while those of the unsaturated acids are soluble.

A number of determinations were conducted and the trials that are close to each other are given in table 1.

TABLE 1
Showing the separation of the natural oil into solid and liquid acids

NO. OF TRIALS	WT. OF OIL USED	UNCORRECTED				CORRECTED			
		Liquid acids		Solid acids		Liquid acids		Solid acids	
		Weight	Per cent	Weight	Per cent	Weight	Per cent	Weight	Per cent
		gram		gram		gram		gram	
1	22.8920	19.0232	83.10	3.4896	15.24	19.2659	84.16	3.2461	14.18
2	49.2454	41.0707	83.40	7.8793	16.00	41.6173	84.51	7.3326	14.89
3	54.123	45.4632	83.99	7.6773	14.18	45.9883	84.97	7.1442	13.20
4	30.3746	25.0805	82.57	4.5259	13.9	25.3772	83.53	3.9305	12.94
Mean			83.26		14.83		84.29		13.8

As seen from table 1 the neutral oil is composed of 84.29 per cent of liquid acids and 13.80 per cent of solid acids.

The unsaturated acids

The mixture of unsaturated acids was found to have the following physical and chemical constants: (The figures in the following table represent the average of several determinations made on the liquid acids.)

Melting point.....	17° to 20°C.
Solidifying point.....	6° to 7°C.
Saponification value.....	192.82
Iodine number.....	143.5
Neutralization value.....	198.65
Mean molecular weight.....	290.94

Analysis of the unsaturated acids. The separation of the liquid acids, found in the unsaturated portion was based on the different solubility of the bromo-compounds in petroleum ether upon bromination. The different bromo-derivatives were separated according to the method of Eiber and Muggenthaler (1903). By this method, the unsaturated acids are dissolved in dry ethyl ether and the solution resulting cooled down to -10° to $-12^{\circ}\text{C}.$ and liquid bromine added very slowly. The mixture is then allowed to stand for two hours in a bath kept at $\pm 2^{\circ}\text{C}.$ of -10° to $-12^{\circ}\text{C}.$ The ethereal solution contained no precipitate, showing the absence of any hexabromo-derivative. It is, therefore, evident that linolenic acid is absent in the mixture, since linolenic hexabromide is insoluble in dry ethyl ether.

The ethereal solution was then repeatedly washed with 10 per cent sodium thiosulfate solution in a separatory funnel in order to remove all of the excess of bromine added. The washed layer was next dehydrated with sodium sulfate. The mixture was allowed to stand for about twenty-four hours in the desk after which the ethereal layer was filtered into a flask and the ether recovered in the usual way. The residue was then boiled

with low boiling point petroleum ether. In this connection it must be remembered that oleic dibromide is very soluble in this solvent while the bromo-compound due to linolic acid is soluble with difficulty.

The boiled solution was allowed to stand for about twenty-four hours in the ice box until crystals of tetrabromide due to linolic acid had separated out. The crystals were filtered through a tared filter paper and the filtrate concentrated to about half its volume. The filter paper containing the precipitate was dried in an electric oven to constant weight. This is reported in table 2 as the first crop of tetrabromide.

After allowing the concentrated filtrate to stand in an ice closet for about forty-eight hours a second crop of crystals was obtained. No further separation was obtained when the filtrate was concentrated further, even after allowing the concentrated mixture to stand in the closet for a period of about three days. The weight of the second crop of crystals was ascertained in the usual way and is reported in table 2 as the second crop of tetrabromide.

The remaining solvent in the mixture was completely eliminated in the usual way and the final residue weighed. The residue represents the whole of the bromo-derivative of oleic acid and a little of linolic acid since by the separation given above it is almost impossible to separate completely all of the bromo-compound due to linolic acid.

The bromine content of the crops and that of the residue was determined by the method used in a previous investigation (Soliven, 1924). The melting point of the different crop of crystals was also determined for purposes of comparison with that of pure linolic tetrabromide.

From the weight of the different crops of crystals the corresponding amount in terms of linolic acid and linolic glyceride was calculated. Also from the bromine content of the residue the proportion of oleic dibromide and linolic dibromide could also be calculated, since pure oleic dibromide contains 36.18 per cent of bromine and linolic dibromide, 53.33 per cent of bromine. The data reported in table 2 were obtained from a series of separations made.

TABLE 2a

Showing the composition of the liquid fatty acids by the bromo-derivative method

Weight of liquid acid used.....	49.0562 grams
Ether insoluble bromide.....	None
First crop of tetrabromide.....	36.5620 grams
Melting point.....	114°C.
Bromine content.....	53.5 per cent
Second crop of tetrabromide.....	6.4548 grams
Melting point.....	113.6°C.
Bromine content.....	52.7 per cent
Residue (mixture of dibromide and tetrabromide).....	47.0230 grams
Bromine content.....	46.00 per cent
Dibromide in residue.....	30.1258 grams
Tetrabromide in residue.....	16.8972 grams

Total tetrabromide found.....	59.6140 grams
Total dibromide found.....	30.1258 grams
Linolic acid found.....	27.4951 grams
Oleic acid found.....	19.2203 grams
Percentages of the constituents found:	
Oleic acid.....	39.18
Linolic acid.....	56.04
Oleic glyceride.....	40.94
Linolic glyceride.....	58.56

TABLE 2b

Showing the composition of the liquid fatty acids by the bromo-derivative method

Weight of liquid acid used.....	64.8672 grams
Ether insoluble bromide.....	None
First crop of tetrabromide.....	14.3782 grams
Bromine content.....	53.1 per cent
Melting point.....	113.2°C.
Second crop of tetrabromide.....	9.6182 grams
Melting point.....	114°C.
Bromine content.....	53.4 per cent
Residue (dibromide and tetrabromide).....	94.0725 grams
Bromine content.....	45.9 per cent
Dibromide in residue.....	40.7616 grams
Tetrabromide in residue.....	53.3109 grams
Total tetrabromide found.....	77.3073 grams
Total dibromide found.....	40.7616 grams
Linolic acid found.....	36.1086 grams
Oleic acid found.....	26.0059 grams
Percentages of the constituents found:	
Oleic acid.....	40.01
Linolic acid.....	55.66
Oleic glyceride.....	41.81
Linolic glyceride.....	58.16

TABLE 2c

Showing the composition of the liquid fatty acids by the bromo-derivative method

Weight of liquid acid used.....	59.6708 grams
Ether insoluble bromide.....	None
First crop of tetrabromide.....	13.0781 grams
Melting point.....	112.9°—113°C.
Bromine content.....	53.6 per cent
Second crop of tetrabromide.....	2.2182 grams
Melting point.....	114°C.
Bromine content.....	53.9 per cent
Residue (dibromide and tetrabromide).....	94.1678 grams
Bromine content.....	46.48 per cent
Dibromide in residue.....	37.6200 grams
Tetrabromide in residue.....	56.5478 grams
Total tetrabromide found.....	71.8441 grams
Total dibromide found.....	37.6200 grams
Linolic acid found.....	33.6962 grams
Oleic acid found.....	24.0016 grams
Percentages of the constituents found:	
Oleic acid.....	40.20
Linolic acid.....	56.10
Oleic glyceride.....	42.01
Linolic glyceride.....	58.62

It may be seen in table 2 that the saturated acids are composed of 39.8 per cent oleic acid and 56.2 per cent linolic acid or 41.5 per cent oleic glyceride and 58.4 per cent linolic glyceride.

The neutral oil contains on the average 84.29 per cent unsaturated acids and 13.8 per cent of solid fatty acids. Translating the analysis of the unsaturated acids into the basis of the neutral oil, data in table 3 are obtained.

TABLE 3
Résumé of table 2. Showing the composition of liquid fatty acids

ACIDS	FOUND	CALCULATED TO THE BASIS OF 100	ACIDS IN ORIGINAL OIL	GLYCERIDES IN ORIGINAL OIL
	<i>per cent</i>	<i>per cent</i>	<i>per cent</i>	<i>per cent</i>
Oleic.....	41.50	41.54	35.21	36.79
Linolic.....	58.40	58.46	49.28	50.50
Total.....	99.90	100.00	84.49	87.29

It may be seen from table 3 that the neutral oil contains on the average 36.79 per cent oleic glyceride and 50.50 per cent of linolic glyceride, making a total of 87.29 per cent, the balance from 100 being due to the glycerides of solid acids.

The saturated acids

The physical and chemical constants of the saturated acids are given in the following tabulation:

Melting point.....	44° to 45°C.
Solidifying point.....	46° to 47°C.
Saponification value.....	292.6
Iodine number.....	9.96

The analyses of the saturated fatty acids were not conducted as there are no proper facilities for this work in the laboratory. It will be done as soon as these facilities are provided.

THE COMPOSITION OF THE SEED KERNEL AND PULP

Following the method of analysis used in a previous investigation by the writer (1924) along the same line, the figures reported in table 4 were obtained.

TABLE 4
Showing the composition of the freshly peeled kernels and fruit pulp

CONSTITUENTS	KERNELS	PULP
	<i>per cent</i>	<i>per cent</i>
Shell (by difference).....	42.88	
Kernels.....	58.12	
Moisture.....	6.80	65.10
Ash.....	4.82	9.03
Ether extract.....	51.89	
Protein (Nitrogen $\times 6.25$).....	23.35	2.81
Crude fiber.....	3.39	
Nitrogen free extract (by difference)....	10.71	

As mentioned elsewhere in this paper the seed is very rich in oil. It is equally rich in protein, there being 23.35 per cent, based on the original sample. The seed contains a small amount of water and a fair amount of crude fiber. In this connection it should be mentioned that the seeds used were all air-dried sample. The seed also contains a fair amount of ash and nitrogen-free extract. Provided that the purgative properties of the nut are carried away with the oil during its extraction, the value of the cake as an animal feed is evident. Moreover, even if purgative properties are in the cake after the extraction of the oil, it would be suitable for feeding purposes if means of separating these properties could be devised. The pulp is very poor in protein, hence could not be utilized as feed. It contains, however, a fairly high percentage of ash, there being 9.03 per cent, based on the original sample. The green pulp contains latex which is in itself bitter. The composition of the bitter principle has been reported to be due to a substance of unknown composition (Anonymous, 1919). If, however, during the course of the ripening of the fruit the bitter principle of the pulp does not undergo any chemical change it could not be used. The isolation of the bitter principle of the pulp, or the purgative principle of the cake and oil has not been attempted.

The ash from the kernel was found to be richer than the ash from the pulp in those constituents analyzed, except in the oxide of potassium and sodium. From data in the table it is evident that the pulp can be used more advantageously as a source of fertilizer than as a source of an animal feed.

TABLE 5
Showing the composition of the ash from the kernels and pulp of the fruit

CONSTITUENTS	KERNEL	PULP
	<i>per cent</i>	<i>per cent</i>
Insoluble matter and silica.....	1.02	3.34
Calcium oxide.....	21.03	5.42
Phosphoric acid anhydride.....	6.03	3.12
Aluminum oxide.....	0.16	0.66
Ferric oxide.....	1.04	0.40
Potassium oxide.....	17.88	36.91
Sodium oxide.....	16.59	23.54
Magnesium oxide.....	9.42	6.00
Sulfur trioxide.....	9.75	1.32

CONCLUSIONS

1. The seed of *Jatropha curcas* is composed of 58.12 per cent kernel and 42.88 per cent shell.
2. The kernels contain 51.89 per cent yellowish oil or 22.23 per cent on the basis of the whole seed.

3. The kernel was found to have the following composition:

Moisture.....	6.80 per cent
Ash.....	4.82 per cent
Ether extract.....	51.89 per cent
Protein.....	23.35 per cent
Crude fiber.....	3.39 per cent
Nitrogen free-extract (obtained by difference)...	10.71 per cent

It would seem that the cake derived from the extraction of the oil may be utilized as feed for animals if the bitter principle is removed. To prove this, feed experiments are necessary.

4. The ash from the kernel was found to have the following composition:

Insoluble matter and silica.....	1.02 per cent
Calcium oxide.....	21.03 per cent
Phosphoric acid anhydride.....	6.03 per cent
Aluminum oxide.....	0.16 per cent
Ferric oxide.....	1.04 per cent
Potassium oxide.....	17.88 per cent
Sodium oxide.....	16.59 per cent
Magnesium oxide.....	9.42 per cent
Sulfur trioxide.....	9.75 per cent

The cake resulting from the extraction of the oil may be found to have value as a source of fertilizer, if properly treated.

5. The pulp can not be used as feed but it may be utilized advantageously as a source of fertilizer, as shown from the following composition of the ash from the pulp. (The pulp contains 9.03 per cent of ash.)

Insoluble matter and silica.....	3.34 per cent
Calcium oxide.....	5.42 per cent
Phosphoric acid anhydride.....	3.12 per cent
Aluminum oxide.....	0.66 per cent
Ferric oxide.....	0.40 per cent
Potassium oxide.....	36.91 per cent
Sodium oxide.....	23.54 per cent
Magnesium oxide.....	6.00 per cent
Sulfur trioxide.....	1.32 per cent

6. The oil is composed of 84.29 per cent of unsaturated fatty acids and 13.80 per cent of saturated fatty acids.

7. The liquid, or unsaturated acids, is composed of 36.79 per cent of olein and 50.50 per cent of linolein expressed on the basis of the neutral oil.

8. Since the glyceride of linolic acid predominates in the neutral oil, it may be considered a semi-drying oil.

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GROWTH AND DEVELOPMENT OF YOUNG RICE PLANTS AS INFLUENCED BY THE FOOD IN THE SEED¹

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WITH TWO TEXT FIGURES

INTRODUCTION

The functions of the parts of a rice seed are known. That the endosperm is the store of food for use by the developing young plant has been long known. But, so far as available literature on germination shows, the amount of sustenance the young rice plant derives from this reserved food, has not yet been ascertained.

During the last three or four years, while trying to study the salt requirements of the young rice plants, our attention has been drawn to the fact that greening of the leaves of this plant becomes evident very soon after sprouting. Usually, it requires only about two days after sprouting (initial germination) for the shoot to become green enough to be able apparently to synthesize its own carbohydrate food. Two questions, therefore, may be asked: (a) If at this stage of the life of the young rice plants, the grain should be detached, for one reason or another, from the developing embryo, can it continue to grow and attain a normal development? (b) How much of the early growth and development of the young rice plant is due exclusively to the food stored in its seed?

This brief study was conducted in the Laboratory of Plant Physiology at the College of Agriculture, Los Baños, from the latter part of June to the end of August, 1927. The cultures were carried out largely by an assistant, Mr. Emilio Macasaet.

MATERIALS, METHODS, AND RESULTS

The plant

The young rice plants were of a lowland variety. The seeds were germinated and seedlings set up in cork stoppers in a manner similar to that described by Espino (1920)². The seedlings were supplied with the culture solutions. The grains were removed from some seedlings three days after sprouting, when the shoots were about three centimeters long. At this time the shoots were somewhat green.

¹ Experiment Station contribution No. 516. Received for publication, January 5, 1928.

² Espino, Rafael B. 1920. Some aspects of the salt requirements of young rice plants. *Philippine Journal of Science* 16: 455-525.

The culture solutions

Fifteen different complete culture solutions (each in duplicate) of Espino's 4-salt type A formed one set of cultures. All these culture media were found by Espino (1920) to be able to grow young rice plants satisfactorily. Hence, they were selected for use in this study. They were prepared as described in the 1920 study; each contained monopotassium phosphate, calcium nitrate, ammonium sulfate and magnesium sulfate. The usual trace of iron was added to each culture solution as iron phosphate.

Each set of cultures was run in duplicate. One set had seedlings with the seeds intact. The other set had seedlings without seeds. The seeds were removed at the time of starting the experiments. These two sets formed what are here designated as *first trial* and *second trial*.

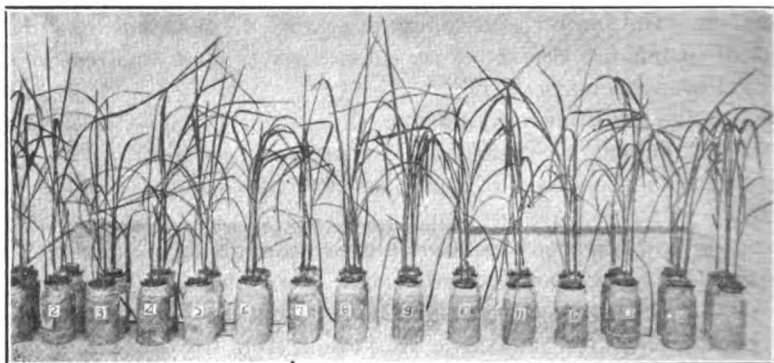


Fig. 1.—Cultures in which the seeds were left intact.

The *first trial* was run from June 22 to July 21, 1927, and the *second trial*, from August 1 to 31, 1927. Each culture solution was changed every two days.

Precautions taken

The seeds were removed carefully, so as not to cause any unnecessary injury to the seedling. The wound or scar left after the removal of the seed was not allowed to touch the culture solution. This precaution prevented infection which is apt to set in in a case of this kind. Care was also taken to prevent the seeds (in the case of the seedlings with seeds) touching the solution, as the young plant draws the food directly from the seed and not after the food has passed out into the culture solution.

Criteria of results

The results are expressed under the following criteria:

External appearance of plants. From time to time the general appearance of the plants in the cultures was observed. The height of the shoots, the length of the roots, and the number and color of leaves were

noted. It was observed that, as a whole, the plants in the seedless cultures were of a slightly paler green and were shorter than those with the seeds on. There was not any constant difference in number of leaves and in the length of roots in the cultures from the two sets.

At the time of harvest, the cultures in the second trial were photographed, (see fig. 1 and 2).

Dry weights of tops. At the time of harvest, the top was severed from the root in each culture. The tops from the different cultures were separately dried and their respective weights determined. The data obtained are recorded in table 1. Under set I in this table, are the data from the cultures where the seeds were not detached. The difference between the dry weight of tops from a culture *with* seeds and that from a corresponding culture *without* seeds was determined. This difference is expressed (see table 1) in term of percentage.

Dry weights of roots. The roots from the different cultures were dried and their dry weights separately determined. The data thus obtained are recorded in table 1.

Dry weights of tops and roots. The dry weights of tops and of roots from each culture were added. This method was followed in the cultures *with* seeds as well as those *without* seeds. A comparison of the data obtained from the two similar cultures was made and the difference is expressed in percentage in table 1.

DISCUSSION OF RESULTS

The results from this rather limited study are here briefly discussed under the twofold objects named in first part of this paper.

Can the young rice plant continue to grow if the seed is removed soon after germinating? The fact that in all the cultures from which the seeds were removed not a single plant died shows beyond question that young rice plants three days old after germination can continue to grow even in the complete absence of the food which the young plants obtain from the seed. There was, however, a marked setback in growth, especially during the very early development of the young rice plants. But later, the *seedless* cultures picked up in growth fast enough to be able to produce plants that were quite well developed, (see fig. 2).

How much of the early growth and development of the young rice plant is due exclusively to the food stored in its seed? Examination of the data in table 1 shows that in term of the criteria of results here employed, invariably the plants *with seeds* were better developed than those *without seeds*. In the two trials, the average difference of the yield of tops from the fifteen cultures *with seeds* and the same number of cultures *without seeds* was 53 per cent. Under yield of roots, the average difference between the fifteen cultures *with seeds* and the fifteen cultures *without seeds* was 53 per cent in

first trial and 47 per cent in the second trial. In the two trials, the average difference between the tops and roots from set I and the tops and roots from set II was 53 per cent. It is, therefore, very apparent that an average of 53 per cent of the early growth and development of the young rice plants was due to the food which was absorbed from the seeds.

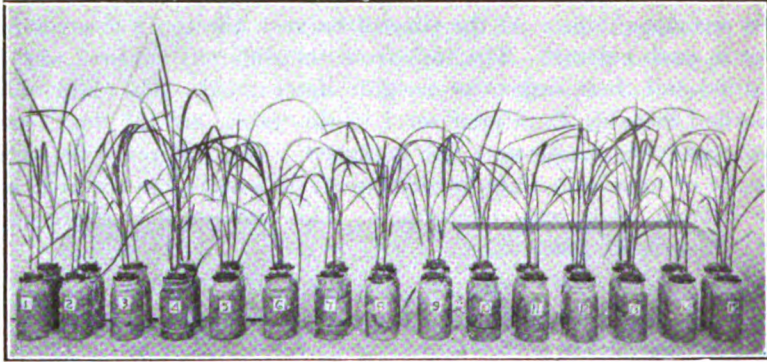


Fig. 2.—Cultures in which the seeds were removed from the seedlings.

SUMMARY OF CONCLUSIONS

1. Removal of the seeds, thus depriving the young rice plants of food for early development, materially retarded the vegetative development, but did not cause the death of the young plants. At the end of thirty days the *seedless* cultures appeared quite well developed.
2. An average of about 53 per cent of the early growth and development of the young rice plants was supported by the food which was absorbed from the seed.

TABLE I

Dry weights of tops and of roots of young rice plants, with and without seeds, grown in complete culture solutions for thirty days

CULTURE NO.	FIRST TRIAL										SECOND TRIAL									
	June 22 to July 21, 1927					August 1 to August 31, 1927					August 1 to August 31, 1927					August 1 to August 31, 1927				
	Tops			Roots			Tops and roots			Differ- ence	Tops			Roots			Tops and roots			Differ- ence
	Set I	Set II	Differ- ence	Set I	Set II	Differ- ence	Set I	Set II	Differ- ence		Set I	Set II	Differ- ence	Set I	Set II	Differ- ence	Set I	Set II	Differ- ence	
	gram	gram	per cent	gram	gram	per cent	gram	gram	per cent		gram	gram	per cent	gram	gram	per cent	gram	gram	per cent	
1	.320	.195	39	.075	.046	39	.395	.241	39		.339	.202	40	.045	.032	29	.384	.234	39	
2	.290	.166	43	.066	.034	48	.356	.200	44		.300	.169	44	.046	.027	41	.346	.196	43	
3	.275	.132	57	.067	.026	61	.342	.158	54		.266	.149	44	.065	.027	58	.331	.176	47	
4	.342	.114	67	.066	.022	67	.408	.138	66		.349	.115	67	.036	.022	37	.385	.137	64	
5	.282	.186	34	.054	.036	33	.336	.222	34		.285	.179	37	.062	.025	60	.377	.204	43	
6	.288	.150	48	.071	.036	49	.359	.186	48		.296	.135	55	.065	.027	58	.361	.162	55	
7	.256	.155	39	.054	.012	78	.310	.167	46		.272	.141	48	.051	.028	45	.323	.169	48	
8	.335	.135	59	.075	.017	77	.410	.152	63		.347	.147	58	.050	.024	52	.397	.171	57	
9	.350	.138	61	.066	.028	58	.416	.166	62		.343	.160	53	.021	.018	14	.364	.178	51	
10	.284	.147	48	.064	.035	45	.348	.182	48		.292	.136	53	.037	.025	32	.329	.161	51	
11	.284	.126	56	.050	.024	52	.334	.150	55		.278	.114	59	.059	.026	56	.337	.140	58	
12	.353	.143	60	.052	.032	38	.405	.176	57		.333	.168	50	.052	.022	58	.385	.190	51	
13	.295	.144	51	.061	.030	51	.356	.174	51		.304	.139	64	.042	.023	45	.376	.162	57	
14	.372	.109	71	.050	.021	58	.422	.130	69		.309	.118	62	.069	.020	71	.378	.138	63	
15	.378	.130	66	.054	.036	33	.432	.166	62		.377	.149	60	.040	.025	47	.417	.174	58	
Average of 15 cultures.			53			53			53							47				53

AMERICAN AND FOREIGN CAPITAL ACQUISITIONS OF THE PHILIPPINE PUBLIC DOMAIN¹

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Of the Department of Rural Economics

WITH TWO CHARTS AND ONE MAP

The Philippine Government is trustee of a vast public domain, over 12,000,000 hectares² of which are still alienable for agricultural purposes. The development of these extensive areas requires large investments of capital. The Philippine Islands being a young country finds its capital resources inadequate to speedily carry on development of so great a magnitude. Countries the world over have witnessed in the early stages of their development the influx of foreign capital and have had to grapple with problems which this capital necessarily entails. In the Philippines during the past quarter of a century, American and foreign capital has been persistently knocking for entrance at her doors, eager and ready to exploit on a large scale the large undeveloped public domain. But the mere mention of foreign capital stirs vehement opposition and antagonism in our conservative and cautious government and among our people. Consequently, up to the present, agriculture remains the one basic industry almost wholly capitalized by domestic capital. Under strict limitations, however, we find today considerable American and foreign capital invested in agricultural enterprises of the country. Substantial areas have been acquired by American and foreign corporations from the public domain. There has been no attempt so far to determine the extent of these holdings, and no study has been made of their relations to the public land policy of the Philippine government. This paper aims to accomplish both.

THE PUBLIC LAND POLICY OF THE PHILIPPINE GOVERNMENT

The enunciation of a public land policy in the administration of the public domain of the country, was embodied in the Act of Congress of July 1, 1902, providing for the administration of the government of the Islands. Congress laid down the fundamental policy that the public domain of the Philippine Islands is to be held in trust by the State primarily for the inhabitants of the country, for disposal in small areas so as to benefit the greatest number. Congress zealously guarded the interests of the people of the

¹Experiment Station contribution No. 517. Received for publication, November 23, 1927.

²Bureau of Forestry estimate.

Islands against any partition of the public domain into large estates. Section 15, Act of Congress, July 1, 1902, reads:

That the Government of the Philippine Islands is hereby authorized and empowered, on such terms as it may prescribe, by general legislation, to provide for the granting or sale and conveyance to actual occupants and settlers and other citizens of said islands such parts and portions of the public domain, other than timber and mineral lands of the United States, in said islands as it may deem wise, not exceeding sixteen hectares to any one person, and for the sale and conveyance of not more than one thousand and twenty-four hectares to any corporation or association of persons.

There was a well-founded fear on the part of Congress when it considered Philippine legislation in 1902, that should no effective checks be made to regulate the acquisition of the public domain of the Philippine Islands, powerful corporations would parcel it out in large blocks. That this limitation on area did not meet with favor among those interests in the United States that saw opportunities for large agricultural investments, was amply shown in the hearings of the Philippine bill before Congress in 1902, when efforts were exerted by private parties to influence the views of its members for a more liberal land policy. As finally adopted, the public land policy laid down in the Act of Congress of July 1, 1902, left very little power to the discretion of the government of the Philippine Islands. The insertion of provisions giving authority to the Philippine government for the purchase of the extensive holdings of religious corporations in the Islands, affords more light on the views of Congress in defining a public land policy for the Philippine Islands. This purchase was considered urgent in view of serious agrarian problems arising from the ownership of large estates by religious corporations. Congress authorized in the Act of July 1, 1902, the purchase of about 160,000 hectares of agricultural lands from various religious orders in the Philippine Islands, and laid down the principle of selling these lands, known as the Friar Estates, on liberal terms, preferably to tenants on the estates. In the discussions before Congress during the hearings of the Philippine bill, there was much divergence of opinion among its members as to the policy to be pursued in the disposition of the Friar Estates, once the purchase was effected. The inevitable question of area which individuals or corporations may acquire from these estates came up for discussion. The fear of exploitation by American capital and the welfare of Filipino tenants on the estates were dominant in the minds of many members of Congress. The view which ultimately prevailed and was embodied in the Act was that the Friar Estates are separate and distinct from public lands and the Philippine government was given the power to determine the manner of their disposition and the areas which may be sold to one individual or corporation.

Machinery to carry into effect the public land policy as defined by the Act of Congress of July 1, 1902, was immediately provided for in the passage on October 7, 1903, by the Philippine Commission of Act 926, entitled

"The Public Land Act," which provided among other things for the manner of selling and leasing of portions of the public domain of the Philippine Islands. On April 26, 1904, after the purchase of the Friar Estates was consummated, the Philippine Commission passed Act 1120 providing for the sale of the estates to Filipino tenants on the land and to others. These laws strengthened the cardinal principle laid down in the act of Congress that the public domain of the Philippine Islands is to be held in trust by the State for disposal in small parcels, primarily for the benefit of inhabitants of the Islands.

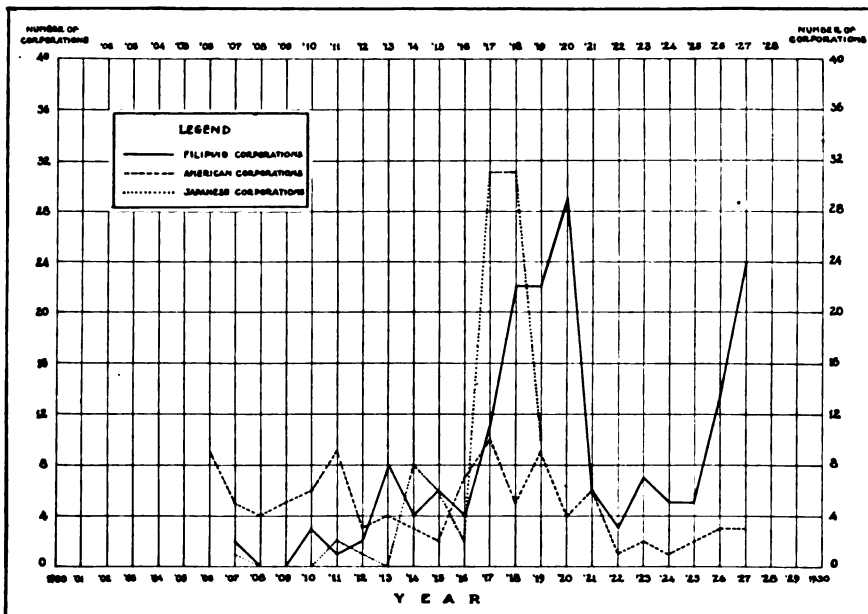


Chart 1.—Showing the number of registrations of agricultural corporations by nationalities and by years.

SALES AND LEASES OF AGRICULTURAL PUBLIC LANDS TO CORPORATIONS

Under the provisions of the Public Land Act of 1903,

any corporation or like association of persons organized under the laws of the Philippine Islands or of the United States, or any State, Territory or insular possession thereof, and authorized to transact business in the Philippine Islands, may purchase a portion of the public domain not to exceed one thousand and twenty-four hectares.

Any corporation of the same character may lease a portion of the public domain not to exceed one thousand and twenty-four hectares for a period of twenty-five years; this lease may be renewed for a like period upon its expiration. The minimum price for sales is fixed by law at ten pesos a hectare and the minimum rate for lease, at fifty centavos per hectare annually. Under the law, all corporations organized in the Philippine

Islands or foreign corporations authorized to transact business in the country may purchase or lease public lands for agricultural purposes within this limitation.

Organization of agricultural corporations

The rigid limitations of the land law proved no bar to the organization of agricultural corporations. Not long after its passage, American as well as foreign corporations began to be organized for purposes of agricultural exploitation.

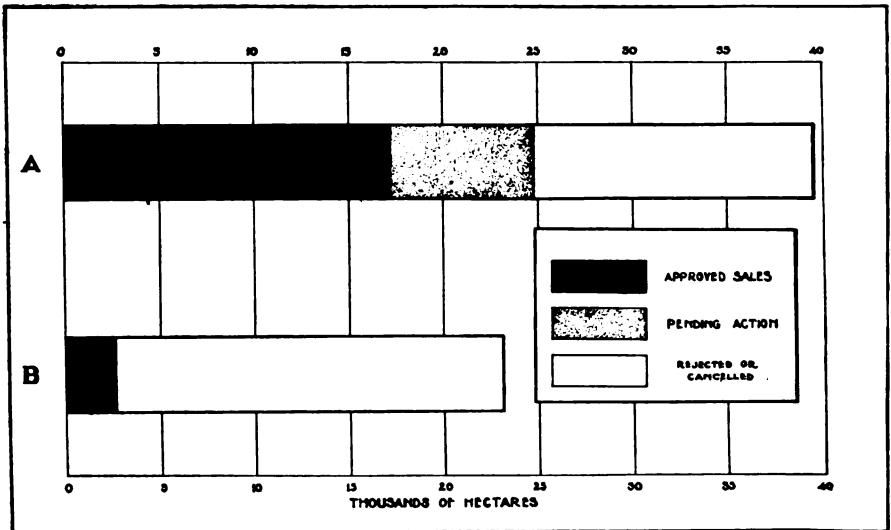


Chart 2.—A—Showing 39,603.7 hectares of agricultural public land covered by sales applications by American corporations and action taken on them by the Bureau of Lands. B.—Showing 23,232.5 hectares of agricultural public land covered by sales applications by foreign corporations and action taken on them by the Bureau of Lands.

Chart 1 shows the number of registrations of agricultural corporations by nationalities and by years. A total of three hundred and eighty-five agricultural corporations has been registered with the Bureau of Commerce and Industry up to September 30, 1927. Of these, one hundred and seventy-seven are capitalized by Filipinos, one hundred and three by Americans, ninety-three by Japanese, and twelve by other foreigners. Reference to chart 1 will show a fair activity in the organization of American corporations from 1906 to 1919, and a marked decline later. There is shown a remarkable activity in the organization of Japanese corporations from 1917 to 1918; and a complete cessation after 1919. Filipino corporations have shown a marked increase in recent years. There has been a lack of interest by American corporations of large capital to invest in agricultural enterprises in the Islands under the limitations of the land law. The Japanese, however, have shown a keen interest to enter this field.

American and foreign acquisitions of the public domain

A large number of American and foreign corporations organized for agricultural purposes never attempted to purchase or lease portions of the public domain. Furthermore, a large proportion of those which filed sale and lease applications with the Bureau of Lands have failed, for various reasons, to obtain possession of the areas applied for.

Chart 2 shows that of 39,603.7 hectares of agricultural public land covered by sales applications by American corporations, only 17,155.4^a hectares have been approved and sold; that 7,611 hectares are still pending action by the Bureau of Lands; and that 14,837.3 hectares have been rejected or cancelled. The chart also shows that of 23,232.5 hectares covered by sales applications by foreign corporations, only 2,647.7 hectares have been approved, and that the remainder has been cancelled or rejected. These figures show that a large proportion of sales applications by American corporations has been rejected or cancelled, and that an unduly large proportion by foreign corporations has met with similar fate.

TABLE 1
Showing sales of the public domain to American corporations

DATE	NAME OF CORPORATION	CAPITAL	LOCATION OF LAND	AREA SOLD
		<i>pesos</i>		<i>hectares</i>
1906	Assinga Co.	30,000	Cagayan.....	907
1910	Basilan Plantation Co.	500,000	Basilan.....	886
1910	Rio Grande Rubber Estate.....	400,000	Cotabato.....	1,023
1911	Baco Rubber Development Co.	40,000	Mindoro.....	200
1913	Mercedes Plantation Co.	20,000	Zamboanga....	72
1913	The Piso Coconut and Cattle Ranch.....	175,000	Davao.....	1,023.7
1913	Talomo Plantation.....	10,000	Davao.....	367
1914	Yakan Plantation Co.	50,000	Basilan.....	450
1914	Kolambugan Lumber and Development Co	150,000	Lanao.....	37
1914	Kumassi Plantation Co.	60,000	Davao.....	802
1915	Riverside Plantation and Co.	50,000	Davao.....	560
1915	The Kulaman Co.	60,000	Davao.....	467
1915	Progressive Stock Raisers' Association....	12,000	Zamboanga....	1,024
1916	Pindisaan Plantation Co.	40,000	Davao.....	654
1917	The Lais Trading and Development Co....	^a	Davao.....	617
1917	Baras Plantation Co.	100,000	Lanao.....	584.7
1917	Tarlac Plantation Co., Inc.	^a	Cotabato.....	952
1917	The Moro Improvement and Trading Co...	50,000	Davao.....	1,021
1918	Mount Apo Plantation Co.	100,000	Davao.....	348
1918	The Lacaron Plantation Co.	30,000	Davao.....	694
1919	The Buenavista Plantation Co.	150,000	Zamboanga....	512.8
1919	Moro Plantation Co.	^a	Davao.....	783.9
1919	Basilan Lumber Co.	750,000	Basilan.....	10
1919	American Rubber Co.	600,000	Basilan.....	922.9
1919	Sumagui Development Co.	40,300	Mindoro.....	600
1922	Mangal Development Co.	25,000	Zamboanga....	17.8
1923	The Malabang Plantation Co.	50,000	Lanao.....	255
1925	Christensen Plantation Co.	100,000	Davao.....	963.6
1925	Van Plantation Co.	100,000	Davao.....	400
		3,692,300		17,155.4

^aData not available.

TABLE 2

Showing sales of the public domain to foreign corporations

DATE	NAME OF CORPORATION	NATIONALITY	CAPITAL	LOCATION OF LAND	AREA SOLD
			<i>pesos</i>		<i>hectares</i>
1907	La Yebana.....	German.....	^a	Isabela.....	168
1912	Basilan Development Co.....	Japanese....	30,000	Basilan.....	457
1914	The Ohta Development Co....	Japanese....	500,000	Davao.....	1,015
1917	Mintal Plantation Co.....	Japanese....	50,000	Davao.....	1,007.7
			580,000		2,647.7

^aData not available.

TABLE 3

Showing leases of the public domain by American corporations

DATE	NAME OF CORPORATION	CAPITAL	LOCATION OF LAND	AREA LEASED
		<i>pesos</i>		<i>hectares</i>
1910	The Sulu Development Co.	20,000	Siasi	1,005
1913	Locanin Plantation Co.	20,000	Bataan	393.1
1913	The Mindanao Estate Co.	^a	Davao	828.4
1916	Agusan Coconut Co.	^a	Bukidnon	1,013.3
1916	Gohn and Haley, Inc.	9,000	Davao	763
1916	Phal and Hendron, Inc.....	12,000	Davao	128.2
1916	The Mindoro Sugar Co.	6,000,000	Mindoro	36.8
1917	Gulf Plantation Co.	100,000	Davao	534.3
1917	Bukidnon Cattle and Coffee Co.	^a	Bukidnon	1,024
1917	Gohn and Haley, Inc.		Davao	81.3
1918	Balabagan Coconut Estate	80,000	Lanao	604
1919	Vega Chica Agricultural Co.	^a	Nueva Ecija ...	224.5
1921	Puncan Plantation Co.	10,000	Nueva Ecija ...	877.9
1922	Celebes Plantation Co.	100,000	Cotabato	1,017.2
1926	Mangal Development Co.	25,000	Zamboanga	511.4
		6,376,000		9,042.4

^aData not available.

TABLE 4

Showing leases of the public domain by foreign corporations

DATE	NAME OF CORPORATION	NATIONALITY	CAPITAL	LOCATION OF LAND	AREA LEASED
			<i>pesos</i>		<i>hectares</i>
1915	Mindanao Agricultural and Commercial Co.	Japanese ..	30,000	Davao	208
1915	South Mindanao Development Co.	Japanese ..	20,000	Davao	763.3
1915	The Catalunan Agricultural Co.	Japanese ..	20,000	Davao	120.7
1916	Lahi River Plantation Co.	Japanese ..	100,000	Davao	166.4
1916	Iharra Development Co.	Japanese ..	50,000	Laguna	65.3
1916	Riverside Plantation Co.	Japanese ..	50,000	Davao	267.2
1916	Bunauan Plantation Co.	Japanese ..	20,000	Davao	365.5
1916	Mindanao Lumber Co.	Chinese ...	300,000	Zamboanga ..	679.7
1917	Cong Lee Colombo Plantation ...	Chinese ...	20,000	Davao	187.9
1918	South Mindanao Agricultural Co.	Japanese ..	49,000	Davao	200.1
1920	Lamitan Plantation Co.	Japanese ..	25,000	Zamboanga ..	764.4
1920	Southern Davao Development Co.	Japanese ..	100,000	Davao	1,017.3
1921	Matsuoka Development Co.	Japanese ..	40,000	Davao	997.3
1921	Tagurano River Plantation Co.	Japanese ..	45,000	Davao	471.8
1921	The Guianga Plantation Co.	Japanese ..	25,000	Davao	323.7
1921	Tagum Plantation Co.	Japanese ..	50,000	Davao	678.4
1921	Lasang Plantation Co.	Japanese ..	20,000	Davao	761.5
1921	Mindanao Reclamation Co.	Japanese ..	50,000	Davao	400.9
1921	Takagi Farming Co.	Japanese ..	50,000	Davao	93.3
1921	Talomo River Agricultural Co.	Japanese ..	50,000	Davao	811.7
1921	Sirawan Plantation Co.	Japanese ..	20,000	Davao	148.6
1921	The Tween River Plantation Co.	Japanese ..	50,000	Davao	320.8
1921	North Talomo Plantation Co.	Japanese ..	30,000	Davao	113.3
1921	Biao Plantation Co.	Japanese ..	10,000	Davao	418.4
1921	Bato Plantation Co.	Japanese ..	20,000	Davao	927.8
1921	The Bayabas Plantation Co.	Japanese ..	10,000	Davao	785.7
1921	Takuman Plantation Co.	Japanese ..	20,000	Davao	330.4
1921	Akamino Bros.' Plantation Co.	Japanese ..	50,000	Davao	219
1921	Panavo Plantation Co.	Japanese ..	20,000	Davao	411
1921	The Ban Yek Sica Plantation and Cattle Ranch Co.	Chinese ...	50,000	Davao	451.9
1921	Doman Plantation Co.	Japanese ..	30,000	Davao	518.8
1922	Zamboanga Development Co.	Japanese ..	50,000	Zamboanga ..	352.1
1922	The Nanyo Plantation Co.	Japanese ..	50,000	Davao	849.5
			1,524,000		15,191.7

Table 1 shows that twenty-nine American corporations with a total capitalization of ₱3,692,300 have purchased 17,155.4 hectares of the agricultural public domain. Table 2 shows that four foreign corporations with a combined capital of ₱580,000 have purchased 2,647.7 hectares. Table 3 shows that fourteen American corporations with a total capitalization of ₱6,376,000 have leased 9,042.4 hectares. Table 4 shows that thirty-three foreign corporations with a combined capital of ₱1,524,000 have leased

15,191.7 hectares. These tables show significant facts. The total holdings of American corporations amount to 26,197.8 hectares, and the total for foreign corporations, 17,839.4 hectares, or a combined total for American and foreign corporations of 44,037.2 hectares. These figures show that the total outside capital holdings in agricultural public lands is not very extensive. Most of the areas were sold to American corporations, while most of the leases have been granted to foreign corporations. It is interesting to note that the foreign corporations which have taken agricultural public lands are almost exclusively Japanese. It is evident from these figures that outside capital investments in agricultural public lands are not large, and these small holdings are attributed to the very rigid limitations set by Congress and carried out by the Public Land Act of October 7, 1903, of the Philippine Commission. It must be borne in mind that these figures do not include the considerable areas of leases and sales granted to individual American citizens; the mineral and timber land concessions; insignificant areas acquired by partnerships; and the holdings of Spanish interests acquired through large royal grants prior to the American administration.

The map shows the geographical distribution of areas sold and leased to American and foreign corporations. The undeveloped regions of Mindanao offer great attractions to outside capital. Most of the corporation holdings are in Davao, Zamboanga, Cotabato, and Basilan. Out of the combined holdings of 44,037.2 hectares by American and foreign corporations in the whole Philippine Islands, 26,389.3 hectares are in Davao. The map further shows the major holdings of American corporations in the Friar Estates amounting to 22,484.5 hectares are found in Mindoro and Luzon.

American acquisitions of the Friar Estates

The disposal of the Friar Estates to American corporations was the subject of much criticism and investigation by Congress in 1910. Soon after the passage of Act 1120 on April 26, 1904, prescribing the manner of selling these estates, a large portion of the 160,000 hectares purchased from religious corporations was sold to Filipino tenants on liberal terms. But difficulty was experienced in disposing of the vacant and undeveloped estates in small parcels. It was believed that sales could be made if large tracts were offered to parties who had the capital to develop them on a large scale. Hence between 1908 and 1914, negotiations were made when opportunities arose for leasing or selling large areas of the Friar Estates to Americans who saw opportunities for extensive agricultural development. A progressive lease of the Tala Estate to an American citizen holding a responsible office in the Philippine government was made in April 20, 1908; this estate was subsequently purchased by the lessee. The Isabela Estate consisting of 19,448 hectares was leased to Americans in January, 1910. The Mindoro Estate, comprising 18,284.8 hectares, was sold to Americans in January, 1910. And subsequently portions of the Calamba Estate passed into American hands. Table 5 shows the major holdings of American corporations of the Friar Estates at present.

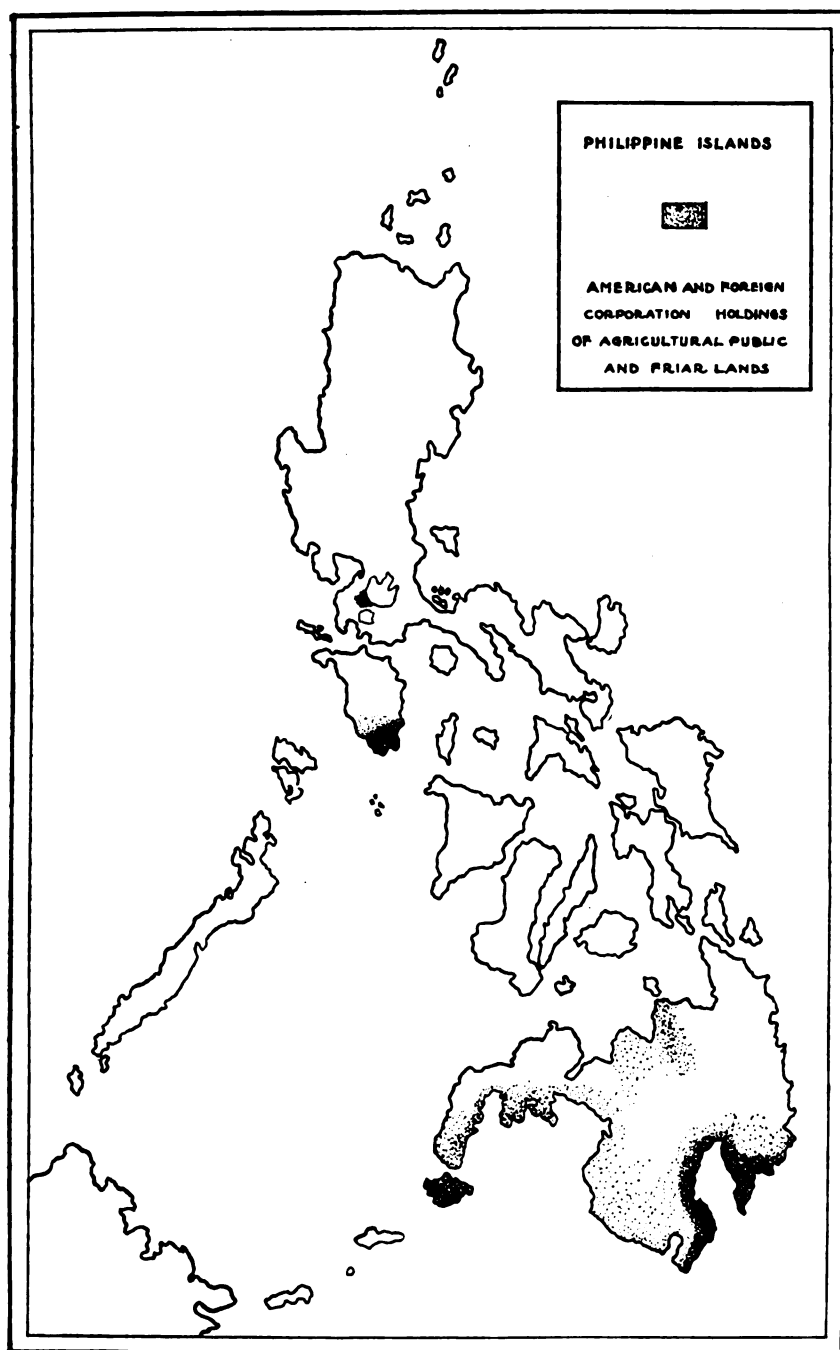


TABLE 5

Showing major holdings of American corporations in the Friar estates

DATE	NAME OF CORPORATION	CAPITAL	ESTATE	AREA SOLD
		<i>pesos</i>		<i>hectares</i>
1910	Mindoro Sugar Co.	6,000,000	Mindoro	18,284.8
1914	Calamba Sugar Estate.....	^a	Calamba	3,288.7
1926	Raymond Kapok Corporation ^b	300,000	Tala	911.0
		6,300,000		22,484.5

^aData not available.^bPurchased from the Carpenter holdings of the Tala Estate.

These sales and leases caused much bitter criticism in Congress during the years from 1910 to 1912 when the cry was vehemently made that the resources of the Philippine Islands were being turned over to the Sugar Trust. There was wholesale condemnation of the motives of Philippine officials who negotiated the sale of very large tracts of the Estates to American interests. An investigation of Philippine officials was made by the Insular Affairs Committee of the House of Representatives, and although the findings cleared the officials of guilt, Congressional opinion, as well as public sentiment in the Philippines, was decidedly against any further sale of the remaining estates in large parcels. The Secretary of War subsequently directed that thereafter the Friar Estates should be sold "subject to the limitations of the Public Land Act". The Philippine Legislature in 1914 stamped approval of this view by passing an act limiting sales of the Friar Estates in areas similar to dispositions of agricultural public lands.

CHANGES IN THE PUBLIC LAND POLICY

The Philippine Autonomy Act of August 29, 1916, gave the sole power to the Philippine Legislature to legislate on matters affecting the unsold portions of the Friar Estates. Subject to the approval of the President of the United States, acts may also be passed relating to the public domain of the Philippine Islands. These provisions gave to the Philippine Legislature wider latitude than was provided in the organic act of 1902 in defining its public land policy. These powers were soon exercised. If Congress was zealous in safeguarding the Philippine public domain from outside capital, the Philippine Legislature soon proved to be more so. The passage of the Public Land Act of November 29, 1919 (No. 2874) prevented further foreign capital acquisitions of the public domain. The prohibitory limitations against foreign capital acquisitions of agricultural public land are embodied in Section 23 of the act which reads in part as follows:

Any corporation or association of which at least *sixty-one per centum* of the capital stock or of any interest in said capital stock belongs wholly to *citizens of the Philippine Islands or of the United States*, and which is organized and constituted under the laws of the Philippine Islands or of the United States or of any State thereof and authorized to transact business in the Philippine Islands, and corporate bodies organized in the Philippine Islands

authorized under their charters to do so, may purchase (or lease) any tract of public agricultural land disposable under this Act, not to exceed * * * one thousand and twenty-four hectares.

This rigid provision of the new law was aimed directly at foreign corporations. While all agricultural corporations organized under the laws of the Philippine Islands were allowed to purchase or lease agricultural public lands under the Public Land Act of October 7, 1903, only corporations the controlling interest of which belongs to citizens of the Philippine Islands or of the United States, are allowed to acquire lands under the new land law. The public domain of the Philippine Islands was therefore closed to foreign exploitation. Reference to chart 1 will show that Japanese corporations which were organized with great activity during 1917 and 1918, ceased completely after 1919. Also a large percentage of failures by foreign corporations to obtain approval of their sales applications, as shown in chart 2, is due to the passage of the new land act, for many of those applications came under the operation of the prohibitory provision of the new law.

Under the present land laws of the Philippine Islands, only American corporations are allowed to acquire portions of the public domain. Chart 1 shows that the number of registrations of American agricultural corporations has decreased rather than increased in recent years. Tables 1 and 3 show that only a small number of American corporations have purchased and leased agricultural public lands. Their total holdings are not very extensive. Obviously, the strict limitation of area to one thousand and twenty-four hectares has not offered strong incentives for American capital to invest in Philippine agricultural enterprises. The question of pursuing a more liberal policy so as to allow a larger area has been persistently raised by those whose interests desire large agricultural holdings, as well as by a number of responsible Philippine officials. Even in the early days, the Philippine Commission repeatedly recommended to Congress to permit much larger holdings, and Governors General have held similar views on the administration of the public domain. Powerful interests in the United States have sought amendments to the present land laws so as to enable them to acquire extensive areas for development of vast plantations. But in the face of all this powerful pressure, Congress and the Philippine Legislature have stood adamant against any liberal modification of the Philippine public land policy.

SUMMARY

1. Congress by Act of July 1, 1902, enunciated a public land policy for the Philippine Islands. The fundamental principle of conserving the vast public domain for the inhabitants of the country was laid down by limitations of area which may be conveyed to corporations.

2. The Public Land Act of October 7, 1903, carried this principle into effect. Under the operation of this law, an American or foreign corporation may acquire agricultural public land not to exceed one thousand and twenty-four hectares.

3. An important change in the public land policy was made by the passage of the Public Land Act of November 29, 1919, which limits the sales and leases of agricultural public lands only to corporations the controlling interest of which belongs to citizens of the Philippine Islands or of the United States.

4. Under the operation of the land laws of the Philippine Islands, the study has shown the following:

(a) From 1906 to September 30, 1927, there have been organized one hundred and three American, ninety-three Japanese, and twelve other foreign agricultural corporations, or a total of two hundred and eight.

(b) Forty-three American corporations have acquired agricultural public lands amounting to 26,197.8 hectares.

(c) Thirty-seven foreign corporations, of which thirty-three are Japanese, have acquired agricultural public lands amounting to 17,839.4 hectares.

(d) Three American corporations have purchased from the Philippine government 22,484.5 hectares of the Friar Estates.

(e) The total figures show eighty-one American and foreign agricultural corporations³ with total acquisitions of agricultural public and Friar lands amounting to 66,521.7 hectares.

5. Acquisitions of the public domain by American and foreign corporations are comparatively small, and this is largely attributed to the very strict area limitations of the land laws which have proved to greatly discourage the entrance of outside capital.

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PUBLISHED CONTRIBUTIONS OF THE COLLEGE OF AGRICULTURE: V.¹

B. M. GONZALEZ

Acting Dean College of Agriculture

There is not a better gauge of the mental capacity and alertness of the workers of an institution than the reports of their work published in journals of known standard. The list of contributions that follows gives a bird's eye view of the variety of problems which are the subject of inquiry by the staff of this institution.

True science aims at the classification of knowledge to render it usable and to form a basis upon which to build up further knowledge on the subject. In the early days of the College a great deal of the work was in the nature of surveys, collecting, and recording current practices in agriculture. With the growth of the institution the next logical step has been to seek to improve upon known practices and to fill gaps evident in unsystematic methods, by trying out the adaptability and applicability of known successful practices elsewhere. Having determined what methods give promise of success in the Philippine field, the third logical step to follow is to put into use such methods as have been found adapted. A great deal of the work of the College at present in its different manifestations aims at greater production and better utilization through the agency of such practices as breeding and selection and proper nutrition of plants and animals, efficient preparation of agricultural products for the market, and the control of pests and diseases of crops.

The College is still greatly hampered by inadequate support and shortage of personnel. Investigations have been prosecuted largely through individual effort and under circumstances which are at times very trying on this account. But knowledge is not found only within magnificent buildings and well-equipped laboratories. In tropical agriculture, particularly, the richest source of information is the field and here the keen observer finds pastures green where others see only a parched desert.

Appreciating the tremendous value that may come from a new principle discovered, or an old principle with a new application developed, the development of the sciences fundamental to agriculture has not proceeded in the College to the extent that would be desirable. So long, however, as there is great wealth of agricultural information that may be readily obtained, and so long as the local application of tried principles gives a rich harvest, the necessity for discovering new means of co-ordinating the different forces

¹ General contribution from the College of Agriculture No. 203.

of nature that affect production will have to be relegated to a secondary position or left in the hands of institutions with better laboratory facilities. It is hoped that with the years greater interest and stimulus in the solution of agricultural problems will merit for the College greater support. With constantly increasing competition among agricultural producers, Philippine agriculture will find it necessary to lower more and more its cost of production through increased yield or more economical methods to enable it to hold its own in the marts of the world, where most of its products have to be offered.

So long as living in the Philippines remains comparatively easy and low, incentive to greater and more economical production will be lukewarm, and many artificial obstacles will be encountered besetting the path of progress. Far-sighted statesmen, however, should be able to see through the apparent glamor and give science a chance to serve Philippine agriculture before necessity and keen competition will force the mass of the populace to demand from its scientific institutions better methods of production. This should be accomplished before actual necessity arises, as the acquisition of knowledge cannot always be hastened.

Congratulations are due to all who have contributed to make the record of the College along investigational lines noteworthy.

II: EXPERIMENT STATION CONTRIBUTIONS

The contributions are numbered serially as reported. For Nos. 1—199, see THE PHILIPPINE AGRICULTURIST XII, No. 7, December, 1923. For Nos. 200—287, see THE PHILIPPINE AGRICULTURIST XIII, No. 10, March, 1925. For Nos. 288—354, see THE PHILIPPINE AGRICULTURIST XIV, No. 10, March, 1926. For Nos. 355—440, see THE PHILIPPINE AGRICULTURIST XV, No. 10, March, 1927.

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A REVIEW: "THE HOME GARDEN HANDBOOK ON GLADIOLUS"^{1,2}

This book gives full information on the culture of gladiolus. Any one with very little knowledge of the plant could be successful in growing it by following the directions given. An excellent feature is the using of sketches instead of photographs for illustrations. These add to the practical value of the book. The introduction given by the president of the American Gladiolus Society is so persuasive as to induce amateur growers of the plant to become members of the society.

The first two chapters give concrete reasons for growing "Glads"; the introduction of the plant to culture in the gardens of America and other places, and its improvement. The next three chapters give complete directions for planting gladiolus. These chapters cover the selection of bulbs for planting, the location and soil requirements, propagation and propagating materials, cultivation and harvesting, and cutting and keeping of flowers. One chapter deals with the methods and practices of breeding for the creation of new varieties. Chapter VII gives extended information on the culture and method of arranging for show purposes. Gladiolus is considered one of those plants that have very few enemies. Those few enemies are well described and directions for destroying them are given in this work.

As a whole, the book gives concise information for the culture in home and commercial gardens of gladiolus; a history of the American Gladiolus Society and a catalogue for a number of the most popular varieties of gladiolus. It is well indexed.

VICENTE M. DAWIS
Of the Department of Agronomy

¹ Rackwell, P. F. 1927. The home garden handbook on Gladiolus. ix+79 p., 60 fig. New York: The Macmillan Company.

² General contribution from the College of Agriculture No. 202.

NOTE: THE ANDELROS CLUB

The Andelros Club, named after Anacleto del Rosario, the first Filipino chemist (born 1860, died 1895), was formed in the Department of Chemistry in the College of Agriculture in 1923. It has for its purposes: (a) the establishment of a close contact between the members of the faculty and the students specializing in chemistry; (b) the establishment of a chemical library.

The establishment of a close contact between faculty and students has been effected through discussions in seminars where abstracts of papers and

original articles are presented, and through informal social gatherings. Original papers dealing with nutrition, vegetable oils, control in sugar manufacture, and with the chemical composition of many Philippine plant and food products have been discussed at the weekly seminars.

The establishment of a library is being made possible by the annual income from "graded" fees from the faculty members and regular fees from the students. The club is now subscribing for the following journals:

Science, Industrial and Engineering Chemistry, Journal of the American Chemical Society, Chemical Abstracts, International Sugar Journal, Sugar, General Electric Review, Physiological Review, Cotton Oil Press, Chemical Review, Journal of Chemical Education.

Besides these journals, gifts, such as the back numbers of *Industrial and Engineering Chemistry, Chemical Abstracts*, framed pictures of eminent chemists, and money have been presented by members of the faculty.

The management of the club is in the hands of faculty members, there being a constitution and annual election of officers.

NICOLAS GALVEZ
Librarian, Andelros Club

EXTENSION DIVISION NOTES

A Coffee Central Project

A few months ago there was considerable agitation on the question of the establishment of crop centrals, as an abaca central, a copra central, etc. Just now, a coffee central is being planned in Lipa, Batangas. The organizer is an American capitalist by the name of Bradley Fairchild. Mr. Fairchild has been going to Lipa regularly the last few weeks interviewing men whom he wishes to make future coffee planters. Conferences are being held for the purpose of drafting a contract between the planters and the central, but at the present writing (January 10, 1928) the final contract has not yet been agreed upon. It is said that Mr. Fairchild is offering the following terms: (1) that the central will be a sort of a bank and will advance money to a planter at 12 per cent interest with his land as security; (2) that each planter will sign a contract with the central which will oblige him to mill his coffee in the central for a period of 30 years; (3) that the central will get 33 per cent of the product as a charge for milling—the planter getting the rest; (4) that the planter can sell his product when he chooses, that is, to the central or to any buyer. These are only some of the terms. They may be altered in the final contract.

Most of the Lipa farmers have not yet decided to accept these proposals of Mr. Fairchild. The Lipa coffee growers are reluctant to accept the thirty-year obligation. Experience with similar long-time contracts have made them cautious. They are also becoming careful about borrowing money when payment is guaranteed by mortgage on their land. They

hesitate to enter into a contract where there is responsibility both in producing the crop and in handling advanced capital. This hesitation shows a lack of business experience.

It is certainly a good sign that the Lipa farmers are carefully weighing the pros and cons of the proposition before coming to final decision. It is not a simple question. There are involved the revival of the Lipa coffee industry; the standardization of the coffee products; employment of labor and managerial ability; comparative profits of the growers and the central in accordance with their respective outlay; continued prosperity of the individuals and the community as a whole, as contributed by this new venture and the financial stability of the industry. These aspects of the question and others of similar nature should be taken into account. Questions of this nature need long deliberation and decision must be always made with caution.

A CATECHISM ON AGRICULTURE

1. What is agriculture?

Agriculture, in a practical sense, is the raising of crops and live stock.

2. Does agriculture advance?

Agriculture advances from a simple form to a more complicated form.

3. What is the simplest form of agriculture?

The simplest form of agriculture consists of planting a patch of ground for a season or two and then abandoning it for another.

4. What is the most advanced form of agriculture?

The most advanced form of agriculture is farm practice based on special knowledge—not a routine practice.

5. What are the two general types of farming?

First.—General, or diversified farming. Second.—Specialized farming.

6. What is general, or diversified farming?

General farming combines the production of plant crops with the production of farm animals.

7. What is specialized farming?

Specialized farming is the production of one crop, usually a money crop.

8. What is the type of farming most commonly practiced in the Philippines?

Specialized farming is most commonly practiced in the Philippines—with rice, coconut, abaca, tobacco, and sugar cane.

9. What has been the general result of this practice?

Generally the result is poor agriculture and consequently a poor farmer.

10. What are the reasons for this result?

There are many reasons: two are: First.—Our cultivated soil becomes poor in plant food. As a result our crop yields per hectare are lower than formerly. Second.—We import every year a large amount of our food stuffs.

11. Which type of farming is advisable?

For the general welfare of the country, diversified farming is better than a one crop system.

12. Which type of farming should a farmer follow?

Each individual should determine this for himself. Each type of farming has advantages and disadvantages. It is advisable to consult experienced farmers or institutions devoted to the study of agriculture in the locality.

13. What objections are there to specialized farming?

First.—The system depends upon market and crop conditions of one crop alone. Failure of crop and failure of market brings serious disaster.

Second.—The system does not provide for the maintenance of productivity.

Third.—It fails to provide for a sufficient live stock industry to consume the waste products of the farm, and make the waste lands productive.

Fourth.—It does not provide for a system of farm management under which labor, work animals, and tools may be used to the fullest advantage.

Fifth.—It usually brings return in cash but once a year.

Sixth.—It does not produce the necessary foods to supply sustenance for the people upon the farm and keep them in health and strength.

Seventh.—It limits knowledge, narrows citizenship and does not foster home building, and does not encourage commercial farming.

14. How should farming be looked upon?

Farming should be looked upon as: First.—As a mode of living. Second.—As a business.

15. What are some of the special things that a farmer should look after, whether in specialized or diversified farming?

1. The farmer must keep his land fertile. He should do this by returning to the soil the plant food by:

a.—Application of animal manure.

b.—Green manuring and rotation of crops.

c.—Judicious application of commercial fertilizers.

2. The farmer should select his seed and his breeding animals.

3. The farmer should feed his plants and animals properly.
 4. The farmer should cultivate his soil thoroughly.
 5. The farmer should control diseases and pests affecting his crops and protect his live stock from diseases and injuries.
 6. The farmer should take good care of his farm tools and implements. He should study to improve them by devices. Good tools are an economy in labor and time.
 7. The farmer should study to lower his cost of production.
 8. The farmer should strive to increase his yield per hectare.
 9. The farmer should always strive to sell his farm products at the highest gain.
 10. The farmer should keep account of his farm expenses and income.
 11. The farmer should know his labor income for his farm operations each year.
 12. The farmer should maintain at least a small cash reserve.
 13. The farmer should take interest in other industries affecting his own.
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EXCHANGE NOTES

If the rural folk have a feeling that they are a bit inferior to other people (or to state it more correctly, that their occupation is an inferior one), it is because: first, they do not know or understand the people engaged in other types of work; and secondly, because they minimize the advantages of the farm and maximize the disadvantages. The first condition could be helped by a better social and community life. The second condition is common to most every one. Education, I believe, will do much to right these conditions.

—*Quarterly of Alpha Zeta.*

The great value of orange juice was pointed out in a paper read by Dr. Stanley Willmott at the British Pharmaceutical Conference, which recently sat at Brighton, England. "Of all citrus juices," he said, "there is little doubt that of the orange is the most valuable. It is, perhaps, the only food other than milk that can with safety be given to infants. New experiments have shown that orange juice has a much higher food value, or vitamin content, than was previously ever suspected. The chairman of the conference said the food value of oranges was remarkably high, and the use of pharmacists of the concentrated juice was a matter of importance.

—*Agricultural Journal, (Queensland).*

There was in session recently at Washington an International Soil Congress. Able and busy individuals from a score of countries found it

worth while to leave their occupations to attend this conference. The President of the United States stole time from packing his vacation trunk to address one of its meetings. All in all, it may be described as a quite respectable occasion. How different from the attitude of the grandees of a century ago toward this same soil! To them soil was a subject, as it was a substance, with which it was considered undignified to contaminate either one's hands or one's mind. The change is significant. To know the soil is now an accomplishment to be admired. Only the dictionary does not yet know this.

In the deliberations of the Washington congress the fact most impressive to the layman is the teeming life which the soil holds. The humble earthworm is an old friend, but this ubiquitous earthling is but a small part, it appears, of the soil's population. Soil bacteria were described to the congress by a dozen scientists. Professor Stoklasa, of Prague, told of how the breathing of these tiny, plantlike germs benefits the roots of higher plants. Dr. Lieske, of Berlin, presented his newest finds, soil bacteria, which can precipitate iron ore and which we have to thank, he believes, for all the deposits of this necessary ore in the world. Dr. Bristol-Roach, of the famous agricultural experiment station at Rothamstead, England, presented at the court of science some tiny living objects which she believes to be intermediate between the free-living algae which can shift for themselves in this none too kindly world and those less able parasitic plantlets, like the molds, which need some one else to prepare food for them.

One of the chief findings of modern soil science, a science the very respectability of which would have been denied in 1827, is that these living creatures of the soil are even more important to man's chief business of agriculture than is the soil's mineral substance. Among the servants of mankind not the least are these tiny, invisible ones that work so earnestly for the farmer, although he treads on them.—*Herald-Tribune* Editorial. June 21, 1927.

—*Gardeners' Chronicle* (America).

The treeless farm presents a very sorry spectacle, and one cannot fail to feel pity for the animals that are obliged to stand or lie in the broiling sun because of the absence of shade of any description.

It should be the aim of every farmer to surround his homestead with trees and to establish moderate-sized clumps in all the paddocks. Awkward corners can be utilised in no more profitable and pleasing manner than by planting them with trees.

In districts where timber for fencing and other purposes is scarce, all land that offers any difficulty in carrying on cultural operations should be planted. The investment, provided that the trees are accorded reasonable care and not interfered with by stock, will in the years to come return a very high rate of interest.

Apart from their economic and utilitarian value, trees, when judiciously arranged, add immensely to the attractiveness of a property and render it pleasingly distinctive, so that strangers in the district are immediately impressed.

—*Agricultural Journal* (Queensland).

A properly equipped University School of Agriculture must have a staff adequate to provide a sufficient variety of courses to produce the different specialists the country requires.

The great output of engineers, doctors, and lawyers from the university colleges is a direct result of the great facilities afforded for those courses. Why not, therefore, give bright young fellows in country schools the opportunity to become leaders in scientific agriculture and other great rural activities?

Agricultural education should be the concern of each type of school in the national scheme, and a great step forward will be taken when an efficient training for rural teachers has been developed, a training which will fit them to teach efficiently a course of study adapted to rural needs to the interests of rural life. No better position could be found for such a training course than in association with an agricultural college of the kind above described.

—*Journal of Agriculture* (New Zealand).

COLLEGE AND ALUMNI NOTES

Dr. Jane Varenia Lee spent a fortnight during the holiday season with her sister, Miss Caroline Virginia Lee, instructor in English Department. Doctor Lee is principal of Louola Murchison, Sprunt Academy for girls, Kiangyin, China.

Mr. H. B. Montalban, assistant chief of the Division of Fisheries, Bureau of Science, was a visitor at the College early in December for conference with Doctor Villadolid.

On December 9, 1927, the class in Horticulture of the Indang Farm School under the leadership of Mr. Catalino Acosta visited the College. They came particularly to hear lectures by some members of the Agronomy Staff. After visiting the different nurseries, the visitors attended the following lectures: "Asexual methods of plant propagation", by Dr. Leon Gonzalez, "Hybridization of pineapples", by Mr. J. M. Capinpin; "The raising and care of vegetables and ornamental plants", by Mr. V. M. Dawis.

Dr. L. B. Uichanco spent the greater part of December on a survey of sugar cane insects in the island of Negros, in co-operation with the Philippine Sugar Association.

Mr. Thongdee Resananda '24, now teaching in Agricultural Teachers' Training School in Korat, Siam, in a letter to Professor Yule acknowledges receipt of *Doctor Research to the Rescue* with words of hearty praise, and asks permission to translate parts in Siamese to use in encouraging scientific agriculture in Siam.

A second edition of *Preparation of Scientific and Technical Papers* by Trelease and Yule will soon be off the press.

Miss Wilson and Miss Whipple of English Department were Cebu visitors during the holiday vacation. They also made a trip to Lanao. Miss Lee of same department with her sister, Doctor Lee visited Silliman Institute at Dumaguete, Or. Negros. Miss Anderson, also of English Department, went to Hongkong and was fortunate in finding conditions quiet enough for her to spend a few days at Shameen, Canton.

Mr. Tomas G. Ferrer, '21, writes Doctor Uichanco from Cabagan, Isabela, in part, as follows:

I am now located in the Cagayan Valley where I am working under the Bureau of Agriculture as agricultural assistant. This is my second year in this region. I like the place and I intend to make it my permanent home. There is plenty of good agricultural public land here; I have already applied for a homestead. The people in this neighborhood are kind and hospitable. There is still plenty of room for graduates of the College who may wish to acquire land. Those who feel reluctant to go south to Mindanao may try their luck in the Cagayan Valley. Only hustlers should come, however, for there is no room here for dead timber. Labor in this place is scarce so that tenant farming would not be practicable.

Mr. Raymundo Sabado, '19, who is now a teacher in the provincial high school of Pangasinan, visited the College during the Christmas holidays.

A "get-together" of the resident members of Class '23 was held in Los Baños, December 2 to welcome back, after a three years study in the United States, Alexander Gordon, a popular member of this class. Mr. Gordon obtained Ph. D. degree from Cornell. The members of '23 present were Messrs. Calixto Zamuco, Pablo Mabbun, and José B. Juliano.

Mr. Ramón P. Tolentino, Jr., assistant director, physical education, makes the following report on activities for the College year.

Baseball

The U. P. Manila Colleges' Baseball Team won this year's University Championship by defeating the strong U. P. Los Baños Colleges' nine in two straight games, 4-0, and 4-2. Better all-around playing was responsible for the rather easy victory of the city team over the aggregation composed mostly of Aggies.

Basketball

U. P. Los Baños came in to its own again when in the University Championships for this year it won once more the U. P. Basket ball title. The Los Baños cagers have been U. P. champions for five consecutive years (1921-1925); the Manila colleges, for two years (1926-1927). In this year's basket ball games, both teams were evenly matched. U. P. Manila won the first game by the close score of 29-27. U. P. Los Baños came back strong and took the second and third games by comfortable margins, the scores being 43-38, and 49-36, respectively.

Relay Carnival

The U. P. Unit IV, or the U. P. Los Baños Colleges' relay team, last year's champion, was unable to defend successfully its title this year. The U. P. Unit II (College of Liberal Arts) relay team won this athletic event by scoring 42 points against 38 of U. P. Los Baños. Unit I (Law, Medicine and Engineering) was third with 10 points. Unit III (Education) withdrew from the race.

Tennis

Roberto Betia, a senior in the College of Agriculture and last year's U. P. Los Baños Colleges' tennis singles winner, won again this year's tennis singles championship. In the finals, he faced and defeated in straight sets Charas Suebsaeng, a Siamese student of the College of Veterinary Science, by the score 6-2, 6-0, 15-13. S. L. Sison, C. Sundarasinha, R. Ordoveza, Magno, and J. Austria also showed up well in this tournament.

Intramural Athletic League

Likewise, in tennis doubles, history repeats itself. R. Betia and J. Austria, last year's winning pair, captured the 1927-1928 tennis doubles championship. They defeated R. Ordoveza and S. L. Sison in the finals, the score being 7-5, 7-5, 6-2.

The end of the 1927-1928 season shows the Freshmen (C. A. '31) of the College of Agriculture carrying the general championship honors in the U. P. Los Baños Athletic League by filing up a total of 233 5/6 points as against the 169 points made by the Seniors (C. A. '28), their closest rivals.

C. Alkan, Inc., donated a silver loving cup to the general champions and a pennant to each of the winners of the different events in the league.

Results of the League games are as follows:

<i>Place</i>	<i>Team</i>	<i>Total of points</i>	<i>Championship</i>	<i>Prizes</i>
1st	C. A. Freshmen	233 5/6	Soccer Football	General championship silver cup pennants and victory trophy. Silver medal (to Severino Martinez—high- est individual point winner.
			Intramural Track and Field	
2nd	C. A. Seniors	169	Basket ball	pennant
			Relays	pennant
3rd	C. A. Sophomores	147		
4th	C. A. Preparatory	143	Volley ball	pennant
5th	Veterinary	88 5/6		
6th	C. A. Juniors	82 1/3		
7th	Forestry	21		

The 1927-1928 U. P. Los Baños Athletic League ended its 1927-1928 Season at the Christmas holidays. In former years, games were played between department teams. This year, under the new organization plan, the teams represented each of the four classes of the College of Agriculture, the Preparatory classes, the School of Forestry and the College of Veterinary Science. A keen rivalry resulted and the athletic league enjoyed a lively season of good fast games. To Mr. Ramón P. Tolentino, Jr., Assistant Physical Director, to the class coaches and captains and to appointed games officials goes much credit for the well-managed program of games marked by good feeling and well-trained players.

INDEX

VOLUME XVI

JUNE, 1927, TO MARCH, 1928

A

- Abacá fiber, the relation between the tensile strength and the length of the individual cells composing it, 441
A catechism on agriculture, 627
ACKERSON, E. W., M. J. BELISH, AND S. F. M. MUSSELH, cited, 479
ADAMS, R. L., cited, 235
Agricultural experiment station, 70
A girl farmer, 299
Almaceneros, local agents buying tobacco, 19
Alumni of the College of Agriculture, (directory of) 127
"A manual of plant breeding in the tropics", a review of, 181
ANDAYA, ISIDORO. The effect of leaf cutting upon the production of rice, *abstract* by V. C. LOPEZ, 267
ANDRADA, AMADO A. Coconut culture in Balbayon Island, Carles, Iloilo, 367
An ideal man of science (quoted), 390
Animal Husbandry Department, 274
Association of Hawaiian Pineapple Cannery, 373
A study of the cost of production and distribution of income of tobacco in Ilagan, Isabela, *abstract* by FRANCISCO M. SACAY, 495
A study of the history, feeding, and management of race horses run under the auspices of the Manila Jockey Club, 351
Asaris in pasture of Poultry-Swine Station, 84
Australian fodder, 358

B

- BAKER, C. F.
Beekeeping, a prospective industry in the Philippines, 108
"Every little bit added to what you've got makes a little bit more", 460
Greetings to the student body of the College of Agriculture, 125
Publications by, 337
Re the financial condition of the tao—let us look in the horse's mouth, 570

The dean replies, 1

- BAKER, CHARLES FULLER, "In Memoriam". Special Number, not indexed. *See* "Contents"
Batangas
horse breeding station, 351
live stock industry in, 561
sugar industry of, 110
Banana dehydrating industry, 115
Barit (*Leersia hexandra* Siv.), green grass for race horses, 358
BAVER, L. D., cited, 307
BELO, JULIAN A., *see* FRONDA, F. M., AND JULIAN A. BELO
BETHKE, R. M., D. C. KENNARD, AND M. C. KIK, cited, 478
Bibliography of books and pamphlets pertaining to youth and the farm (note on), 55
Bishop Museum, 373
BIERRY, H., cited, 513
Books, preserving, in the tropics, 56
Book, MENDIOLA'S, 181
Branding cattle, 580
BRILL, H. C., H. D. PARKER, AND H. S. YATES, cited, 461
British India, cultivated area of, 506
BROWN, E. cited, 35
Bull, selection of, 572
BULMANN, E., cited, 307
Bureau
Agriculture, 111
Education, 185, 121
Public Works, 303
BURGOS, CARLOS X., cited, 477
"By their fruits ye shall know them", (Alumni of College of Agriculture by classes), 127

C

- California Fruit Growers' Exchange, 381
CALVO, DIONISIO. Tillering of rice, 89
Carabaos, dehorned, 107
Carp (*Cyprinus carpio*), 79
CASPARIS, HORTON., P. G. SHIPLEY, AND BENJAMIN KRAMER, cited, 479

Cassava

machine, 112

production of, in the Philippines, 433

Castration of cattle, 579

Cattle raising under Philippine conditions, 571

Cattle range at the Hacienda del Rosario, 391

Character (BOK, quoted), 54

CHICK, H., E. J. DALYELL, M. HUME, H. M. M. MACKAY, AND H. H. SMITH, cited, 479

Citrus

by-products industry in California, 497

industry in Batangas, 111

Climax grain drill, 472

Cocoa, exports of, from Gold Coast, 56

Coconut

culture in Balbagon Island, Carles, Iloilo, 367

oil, germicidal properties of mixture of, with kerosene, 521

products, chemical studies on, 461

Cogonal to teaching plant, from, 187

COLLADO, E. G., *see* SANTOS, F. O., AND E. G. COLLADO

College of Agriculture, graduates of, 1

College and alumni notes, 57, 116, 274, 331, 456, 566, 631, 383

Co-operative societies in Europe, 327

COPELAND, —, cited, 441

Copra

effect of water upon the deterioration of, 461

water absorption capacity of, 461

Corn

effect of climate upon the production of, 109

uses of, 498

Cost of

Cantonese pullets, 36

White Leghorn, 36

Wyandottes, 35

CRUZ, AMADO J. DE LA. Non-gas electrodes for pH determinations, 307

CUMBERLAND, WILLIAM W., listed, 33

D

Dairying in Japan, 286

Dairy show, national, 55

DAVID, EMILIO T. A study of the root system of rice *abstract* by SIMPLICIO OLIVEROS, 53

DAWIS, VICENTE M. A review: "The home garden handbook on *Gladiolus*," 625

DEAN, A. L. Note: An entomological survey of the Pacific (reprinted), 373

DE JESUS, ZACARIAS. The germicidal properties of the mixture of kerosene and coconut oil, 521

Department of

Agricultural Chemistry, 189

Agricultural Engineering, 193

Agronomy, 193

Animal Husbandry, 206

English, 211

Entomology, 212

Plant Pathology, 214

Plant Physiology, 216

Rural Economics, 222

DERECHO, CONSTANTINO G. The relation between the tensile strength of an abacá fiber and the length of the individual fiber composing it, 441

Diversified farming, 305, 501, 502

Diversification in the Philippines, the need of, 560

"Doctor Research to the Rescue," 60

Duroc Jerseys, 557

E

Education and agricultural promotion in Japan, 3, 67, 281

Eggs

hatching qualities of, effect of sunlight on the, 477

incubators for, 33

EIJKMAN, C., C. J. C. VAN HOOGENHUIJZE, AND F. J. G. DERKS, cited, 513

ELAYDA, I., M. LOPEZ, AND P. DAVID, listed, 33

EMERY, J. A., AND R. R. HENLEY, cited, 462

Employer and employee, the relation between, 337

Entomological survey of the Pacific, 373

ESPINO, R. B. Growth and development of young rice plants as influenced by the food in the seed, 597

ESPINO, —, cited, 441

ESPINO, —, AND ESGUERRA, —, etc., cited, 441

Exchange notes, 55, 114, 272, 329, 381, 454, 507, 564, 629

Extension division notes, 110, 268, 323, 376, 451, 501, 560, 626

F

Families of flowering plants, 389

Farm animals, 71

Feed

anay, 38

charcoal, 39

copra meal, 38

corn meal, 38

cracked corn, 38

dry mash, 38

palay, 38

rice bran, 38

shrimps, 38
 white ants, 38
 FELICIANO, VICTOR T. Cost of raising pigs from the time sows are bred until the pigs are weaned, 81
 Fertilizer
 barnyard manure, 68
 commercial, 68
 compost, 68
 fish guano, 68
 rice bran, 68
 source of, 595
 wood ash, 68
 Fisheries of Bayambang, Pangasinan, 73
 FREY, R. W., I. D. CLARKE, AND N. P. VEITCH, cited, 253
 From cogonal to teaching plant, 187
 FRONDA, F. M., AND JULIAN A. BELO. Effects of sunlight on the hatching qualities of eggs, 477
 cited, 35, 477
 Fruit preservation, 271
 Future contributions of the tropics, 450

G

GALVEZ, NICOLAS. Note: The Andelos Club, 625
 GAMBLE, J. S., cited, 587
 GANA, VICENTE A., cited, 253
 Garden, the glory of the, (reprinted), 387
 GAY, FREDERICK P. Research (quoted), 499
 Gardening, an ancient activity (reprinted), 388
 Germicidal properties of the mixture of kerosene and coconut oil, 521
 God give us men (quoted), 54
 Gold Coast, exports of cocoa, 56
 Good farmer is the good business man, the, (quoted), 496
 GONZALEZ, B. M., Education and agricultural promotion in Japan: III. Research work, 3
 IV. Promotion of agriculture, 67
 V. Stock raising, 281
 GONZALEZ, B. M. In retrospect, 121
 GONZALEZ, B. M. Published contributions of the College of Agriculture: V, 617
 GONZALEZ, JOAQUIN J. Medal of, 55
 GOWEN, JOHN W., J. M. MURRAY, N. E. GOOCH, AND FORREST B. AMES, cited, 478
 Graduates of the College of Agriculture students and, by years, 161
 summary of present occupation of, 160
 GRAHAM, W. R., cited, 35
 Grass family, 390
 GRAY, D. T. cited, 36

Groundnuts (peanuts) a subsidiary product in Japan, 68
 GUERRERO, JOAQUIN, cited, 13
 GUSSEROW, —, cited, 589

H

HARRIS, L. J., cited, 308
 HART, C. B., H. STEENBOCK, S. LEPKOVSKY, S. W. F. KLETZIEN, J. G. HALPIN, AND O. N. JOHNSON, cited, 478, 479
 HAUGE, M. S., AND C. W. CARRICK, cited, 514
 Hawaiian Sugar Planter's Association, financial support of entomological survey of the Pacific, pledge, 373
 HAYNES, WILLIAM. Science as culture (reprinted), 279
 He cannot read his tombstone when he's dead (reprinted), 54
 HECTOR, G. P., cited, 90
 HERRICK, C. A., J. E. ACKERT, AND BERTHA L. DANHEIM, cited, 478
 HESS, A. F., cited, 479
 HESS, A. F., L. J. UNGER, AND A. M. PAPPENHEIMER, cited, 479
 HESTER, EVETT D., listed, 298
 HILL, HIBBERT WINSLOW, cited, 522
 HOOVER, HERBERT. The nation and science (quoted), 511
 Honors (quoted), 280
 Horses
 in Japan, 281
 race, run under the auspices of the Manila Jockey Club, history, feeding and management, 351
 Horse-beans as a second crop after rice in Japan, 68
 How to get the best out of your job (quoted), 459
 HUGHES, J. S., L. F. PAYNE, AND W. LATSHAW, cited, 477

I

INCIONG, ANTERO, listed, 59
 India, a new agricultural journal in, 449
 In illo tempore, 173
 Indigo on upland farms in Japan, 68
 In retrospect, 121
 International soil congress of Washington, D. C., 629

J

JACK, H. W., cited, 90
 JACOBSON, H. O., cited, 89
 Japan
 promotion of agriculture in, 67
 agricultural experiment stations, 70
 farm animals, 71

- intensification of culture, 68
 land adjustment, 69
 land reclamation, 68
 price regulation, 69
 rice conservation, 70
 research work in, 3
 governmental research institutions, 3
 imperial universities, 7
 learned societies, 8
 private research institutions, 5
 stock raising in, 281
 cattle, 285
 dairying, 286
 horses, 281
 stallion depot, 283
 imperial zootechnical experiment station, 292
 other live stock promotion agencies, 294
 poultry, 289
 sheep, 290
 breeding station, 290
 number of, 291
 swine, 288
 JARLIEN, M. A., AND D. G. GEONEWARDENE, cited, 462
 JESUS, ZACARIAS DE. The germicidal properties of the mixture of kerosene and coconut oil, 521
 JIMENEZ, MATEO D., abstract by, 109
 JOHNSON, O. R., AND B. H. FRANCE, listed, 48
- K**
- KALAW, MOISES M. Some economic phases of rice production in some towns of Laguna, 297
 KER, R. H., cited, 462
 Kerosene, germicidal properties of mixture of, with coconut oil, 521
 Kidney worms, infestation of Poultry-Swine Station at Los Baños, 84
 KLING, RUDYARD. The glory of the garden (reprinted), 387
 KLEIN, OTTO, cited, 587
 Korea, beans from, 68
- L**
- Laguna, sugar industry of, 110
 LA MER, V. K., AND T. R. PARSONS, cited, 308
 Land reclamation in Japan, 68
 Last rites for Our Dean, the, 223
 LAVA, V. G. Chemical studies on coconut products: I. The critical molding-moisture content of copra, and some methods of preserving it, 461
 The relation between employer and employee, 337
 LEONCIO, MARTIN O., cited, 36
 LEVENE, P. A., AND M. MUHLFELD, cited, 514
 LEVY-BRUHL, L. An ideal man of science (quoted), 390
 LEWKOWITSCH, J., cited, 526, 587
 LINA, VALENTIN K. A study of the history, feeding, and management of race horses run under the auspices of the Manila Jockey Club, 351
 Live stock fair, the, 1927, 105
 LONDSDALE, J. M., cited, 89
 LOPEZ, VICTORIANO C., abstract by, 267
 Los Baños' Biological Club, 13, 49
- M**
- MABBUN, PABLO N.
 Is there a solution? 535
 Study of the Tobacco Grower's Association Inc. of Tuguegarao, Cagayan, 19
 MADAMBA, ULPIANO V., listed, 33
 A study of the cost of production and distribution of income of tobacco in Ilagan, Isabela, abstract by FRANCISCO M. SACAY, 495
 Manchuria, beans from, 68
 MATTHEWS, —, cited, 441
 MCCOLLUM, E. V., AND M. DAVIS, 513
 MENDIOLA, N. B., AND J. O. UNITE, cited, 544
 MENOR, PAULINO C. The effect of climate upon the production of corn, abstract by MATEO D. JIMENEZ, 109
 MERCADO, TORIBIO, cited, 543
 Methuselah (reprinted), 280
 Middlemen, agents for marketing, 31
 MILLER, HUGO H., cited, 298
 Molasses for race horses, 359
 MONDOÑEDO, MARIANO. The 1927 live stock fair, 105
 MONTEMAYOR, ZOSIMO. Mañabol fisheries of Bayambang, Pangasinan, 73
 MORALES, EUGENIO M. A study of (P. B. 119×C.A.C. 87)F₁ hybrid and other sugar cane seedlings and their parents, 543
 MORAN, C. The crop surplus: How chemistry is helping to solve the problem (reprinted), 497
 Muscovado sugar mills in the Philippines, 329
- N**
- NELSON, V. E., C. J. FULMER, AND R. CESSNA, cited, 513
 New books and other publications added to the Library of the College of Agriculture, 62, 333
 New South Wales "Better Farming Train" in, 114
 Night soil, as a fertilizer, 68
 Nipah, tapping of, in the Philippines, Borneo and Federated Malay States, 114

O

- Observations on range cattle at the Hacienda Del Rosario, Cainta, Rizal, 391
 OLIVEROS, SIMPLICIO, abstract by, 53
 Orange, 497
 juice, great value of, 629
 oil from, 497
 pulp of, 497
 OPTIZ, K., cited, 90
 Our farmer vanguard, 165

P

- PACINI, A. J. P., AND D. W. RUSSEL, cited, 513
 PAJE, PEDRO S. The cost of raising pullets under conditions existing in the College of Agriculture, 35
 PALISOC, ILDEFONSO A. Some experiments on farm tanning, 253
 Palm family, number of species of, 390
 Panama diseases of banana carried by trash, 330
 PARK, EDWARD A., cited, 477
 PARR, A. G., cited, 89
 Pasture management, 582
 Peanut, *Arachis hypogaea*, growing of, from cuttings, in the Philippines, 13
 varieties of, 14
 Peas, cultivation of in Japan, 68
 PENDLETON, ROBERT L., Charles Fuller Baker's final contribution to science, 225
 pH determinations, non-gas electrodes for, 307
Pericyma cruegeri (Butler), 229
Perkinsiella vastatrix Breddin, 397
 Pigs
 cost of raising of, 81
 ripe bananas as feed for, 56
 PHILIPS, A. G., cited, 36
 Population of Japan, density of, 67
 PORQUEZ, PEDRO P., cited, 521
 Poultry in Japan, 289
 POWICK, W. C., listed, 462
 Private research institution in Japan, 6
 Progress of tobacco co-operative marketing in Cagayan, 341
 PRONTO, JUAN. Tenancy on rice holdings in the municipality of San Felipe, province of Zambales, abstract by FRANCISCO M. SACAY, 374
 Published contributions for the College of Agriculture arranged by departments, 189
 Published contributions of the College of Agriculture: V, 617
 Pullets, the cost of raising, under conditions existing in the College of Agriculture, 35

Q

- Quadrature parts of conics, 447

R

- RAYMUNDO, MARIANO B., An experiment in the use of a grain drill in reducing the cost of planting rice, 471
 cited, 477
 Lowering cost of rice production, 9
 Read, reflect, act, 340
 Red beans, in northern island of Japan, for confectionery, 68
 RESANANDA, NAI THONGDEE, cited, 35
 Research and practice (reprinted), 227
 Rice
 binder for harvesting, 11
 cost of planting, an experiment in the use of a grain drill in reducing the, 471
 cost of producing, 1926-1927, 235
 cultivators for, 10
 effect of leaf cutting upon the production of, 267
 growing of, 9
 hand weeding of, 11
 lowland, 53
 tillering habit, 102
 varieties of, 102
 method of growing, 9
 manurial requirements of, 71
 plants, growth and development of young, as influenced by the food in the seed, 597
 production, lowering cost of, 9
 some economic phases of production in some towns of Laguna, 297
 tillering of, 89
 trade, 69
 upland, 53
 method of cultivating, 19
 method of growing, 19
 root system, a study of, 53
 varieties, 89
 RIDDLE, O., cited, 481
 ROA, MANUEL A. Quadrature parts of conics, 447
 RODIS, FILOTEO BUHAY, cited, 298
 RODRIGO, P. A. Growing peanuts from cuttings, 13
 cited, 90
 Rose family, varieties and species, 390
 ROXAS, HILARIO A. *Pericyma cruegeri* (Butler): Its life history and economic importance (Noctuidae, Lepidoptera), 229

S

- SACAY, FRANCISCO M.
 abstract by, 375, 496
 The cost of producing rice, 1926-1927, 235
 Salt, mixed with poultry feed, 115
 Salting feed of cattle, 577
 SANTOS, F. O., cited, 513

- SANTOS, F. O., AND E. G. COLLADO. The anti-beriberi vitamin content of sweet potato leaves and shoots, 513
- SARAO, FELIX B., *see* VILLEGAS, VALENTE AND FELIX B. SARAO.
- Science as culture (reprinted), 279
- Siam, area devoted to rice in, 55
- Sheep in Japan, 290
- SHERMAN, H. C., AND S. S. SMITH, cited, 513
- SHIMAZONO, J., cited, 515
- SHOUP, GEO. R., cited, 43
- SOLIVEN, FLORENCIO
cited, 587
The seed and oil of *Jatropha curcas*, 587
- Soybeans, as subsidiary farm crop, 68
- Soybean, uses of, 565
- Students and graduates of the College of Agriculture by years, 161
- Sugar cane leaf-hopper, 397
- SUMAGIT, F. S., cited, 543
- Summary of the present occupations of the graduates of the College of Agriculture, 160
- SUMNER, F., cited, 90
- Sunflower family, genera and species of, 390
- SWARTHOUT, A. V., cited, 33
- Sweet potatoes
anti-beriberi vitamin content of, 513
secondary crop of Japan, 68
- Swine, in Japan, 288

T

- Tanning, some experiments on farm, 253
- TAVERNETTI, THOMAS. What advice shall we give to our graduates? (reprinted), 569
- Tenancy in Zambales, 374
- TERUEL, EUSEBIO, cited, 298
- TIDEN, H., cited, 90
- The new man at the helm, 277
- Then . . . Now, 178
- The possibilities of cassava production in the Philippines, 433
- The relation between the tensile strength of an abacá fiber and the length of the individual cells composing it, 441
- The sugar cane leaf-hopper *Perkinsiella vastatrix* Breddin (Delphacidae, Homoptera), 397

Tobacco

- co-operative marketing in Cagayan, progress of, 341
- curing of, 538
- Growers' Association Inc.
a study of, 19
community curing sheds of, 25
- In Ilagan, Isabela, a study of the cost of production and distribution of income of, 495
- Tuguegarao, Cagayan, 19, 341

U

- URBINO, CORNELIO M. The sugar cane leaf-hopper, *Perkinsiella vastatrix* Breddin (Delphacidae, Homoptera), 397

V

- VEDDER, E. B., cited, 516
- VEDDER, E. B., AND E. CLARK, cited, 514
- VELMONTE, JOSÉ E. American and foreign capital acquisitions of the Philippine public domain, 603
- Veterinary supplies, 585
- VILLEGAS, VALENTE
Cattle raising under Philippine conditions, 571
AND F. B. SARAO. Observations on range cattle at the Hacienda del Rosario, Cainta, Rizal, 391

W

- WALKER, H. G., cited, 461
- "Wealth awaits you on the farm," 58
- What advice shall we give to our graduates (reprinted), 569
- WINSHIP, E. A., Great farmers (reprinted), 557
- WITHYCOMBE, J., cited, 35
- What are your answers—yes or no (reprinted), 279
- What they say about Mendiola's book, 181
- World's farmers get together, 65

Z

- Zambales, tenancy in the municipality of San Felipe *abstract* by FRANCISCO M SACAY, 374

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CONTENTS

VOLUME XVII

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NUMBER 1, JUNE, 1928

Vocational education. B. M. GONZALEZ.....	1
A report on an agricultural investigation trip to Java, Federated Malay States, and Borneo. N. B. MENDIOLA.....	3
The seasonal distribution of egg production: The normal egg production curve. F. M. FRONDA.....	25
Comparative nutritive values of different salts of ammonium. ELEUTERIO PALISOC....	37
Note: Introduced coffees lose resistance to <i>Hemileia vastatrix</i> Berkeley and Broome. PEDRO A. DAVID.....	45
Extension Division notes.....	51
Exchange notes from— <i>Butter, Cheese and Egg Journal</i> (Wisconsin), <i>Capper's Farmer</i> (Kansas), <i>Journal of Education</i> (Wisconsin), <i>The Journal of Agriculture</i> (Australia), <i>Journal of Agriculture</i> (New Zealand), <i>Agricultural Gazette</i> (New South Wales), <i>The</i> <i>American Review of Reviews</i> (New York), <i>Prairie Farmer</i> (Illinois).....	53
College and alumni notes.....	55

NUMBER 2, JULY, 1928

What a University should do for its students.....	59
Practical directions for coffee planting. PEDRO A. DAVID.....	65
Studies on the correlation between the seed and straw production of some field legumes. P. A. RODRIGO.....	83
Report on recuperative growths within a year of some plants injured by a typhoon. RAFAEL B. ESPINO.....	89
A comparative study of the effect of copra meal and dried shrimps as supplement in rations for laying hens. JOSÉ A. SERRANO.....	95
A comparative study of corn and cassava as feeds for hogs: II. Ground corn vs. raw chopped cassava. MARIANO MONDOÑEDO.....	105
The Baker Memorial Fund.....	109
Extension Division notes.....	110
Exchange notes from— <i>Butter, Cheese and Egg Journal</i> (Wisconsin), <i>Tropical Agriculture</i> , <i>Journal of Agriculture</i> (Victoria), <i>Capper's Farmer</i> (Kansas), <i>California Cultivator</i> , <i>Tropical Life</i> , <i>The Australian Sugar Journal</i> , <i>Queensland Agricultural Journal</i>	111
College and alumni notes.....	113

NUMBER 3, AUGUST, 1928

Co-operation. C. F. BAKER.....	115
The measure of a man.....	116
A gravity gate, or simple self-closing gate. ALEXANDER GORDON.....	117
Proximate analysis of some Philippine shellfish. SEVERINO B. ETORMA.....	125
The culture and cost of Barit in Bay, Laguna. RAMON C. ORDOVEZA.....	137
The composition of commercial sugar from Philippine centrals. DELFIN J. SUERTE... ..	149
Note: Production of Pyrethrum flowers in Japan.....	153
Extension Division notes.....	154
Exchange Notes from— <i>The Planter and Sugar Manufacturer</i> , <i>The American Review of</i> <i>Reviews</i> (New York), <i>Industrial Bulletin</i> of ARTHUR D. LITTLE, Inc., <i>Prairie Farmer</i> (Illinois).....	156
College and alumni notes.....	158

NUMBER 4, SEPTEMBER, 1928

Some possibilities in breeding plants used for cover, green manure, and shade. NEMESIO B. MENDIOLA.....	159
Chemical studies on coconut products: II. Utilization of the coconut. N. GALVEZ, R. MORENO, AND V. G. LAVA.....	163
Pathological lesions caused by an undescribed <i>Cooperia</i> in a carabao. A. K. GOMEZ.	169
Effects upon rice plants of changing the moisture content of soil. FELICIANO T. PANTALEON.....	173
Plowing under legumes by the use of single-animal plows. CHARAS S. SUNDARASINHA....	187
Doctor Manuel L. Roxas: An appreciation. B. M. GONZALEZ.....	197
Note: The Baker collection.....	199
A review: "Practical Poultry Farming". F. M. FRONDA.....	201
Extension Division notes.....	203
Exchange notes from— <i>California Cultivator</i> , <i>Journal of Agriculture</i> (Victoria), <i>The Prairie Farmer</i> (Illinois), <i>Poona Agricultural College Magazine</i> (India), <i>American Poultry Journal</i> , <i>The Planter and Sugar Manufacturer</i>	208
College and alumni notes.....	209

NUMBER 5, OCTOBER, 1928

Short course in agriculture.....	211
The Japanese Imperial Government Institute for Nutrition. F. O. SANTOS.....	215
Gray spot, or blight, of coconut. FELIPE CORTEZ.....	223
A study of the feeding, care, and management of native calesa horses at Los Baños, Laguna. ANTERO P. INCIONG.....	243
The chemical composition of Philippine fishes. AMADO N. BALAGTAS.....	253
Notes on an outbreak of poultry epidemic. FRANCISCO GO KEE, M.D.....	263
Extension Division notes.....	267
Exchange notes from— <i>Butter and Cheese Journal</i> , <i>The Prairie Farmer</i> (Illinois), <i>Science</i> , <i>Tropical Life</i> , <i>The Iowa Agriculturist</i> (Iowa State College), <i>Commerce Reports</i> (U. S. A.) <i>Agricultural Gazette</i> (N. S. W.).....	269
College and alumni notes.....	271

NUMBER 6, NOVEMBER, 1928

Vocational teachers of agriculture in North Carolina.....	275
A report on the asexual inheritance of "many-eyed" character of sugar cane. TORIBIO MERCADO.....	277
Our farm labor supply. PABLO N. MABBUN.....	287
A <i>Fusarium</i> causing bulb rot of onion in the Philippines. MACARIO A. PALO.....	301
Notes on yield of some species of coffee grown on the College farm. JOSÉ C. RAMOS.....	317
A word of comment on Gordon's gravity gate. MANUEL A. ROA.....	319
Abstract: "Corn production as affected by some common manures". FELIX N. CAMBA.....	323
Note: "Preparation of scientific and technical papers".....	324
Extension Division notes.....	325
Exchange notes from— <i>Capper's Farmer</i> , <i>Science</i> , <i>California Cultivator</i> , <i>The Agricultural Gazette</i> of N. S. W.....	327
College and alumni notes.....	329

NUMBER 7, DECEMBER, 1928

The main business of science.....	331
Third list of cyanophoric plants of Maquiling region. FERNANDO DE PERALTA.....	333
The behavior of antimony electrode in buffered and unbuffered solutions. V. G. LAVA AND E. D. HEMEDAS.....	337
Philippine farmers' tax guide. JOSÉ E. VELMONTE.....	351
A study on the growth of coconut. J. BUENO F. FANDIÑO.....	361
A study on the preparation of hog ration as related to growth and development of pigs. SALVADOR F. BOLIVAR.....	367
Some notes on the Fourth International Congress of Entomology. FRANCISCO M. SACAY..	381

Abstract: "The effect of borders in farm crops experiment". CLEMENTE E. YANGO...	385
Extension Division notes.....	386
Exchange notes from— <i>Science, The Agricultural Gazette of N. S. W., Commerce Reports</i> (U. S. A.), <i>The Farmer and Stockman, Butter and Cheese Journal, The Prairie Farmer</i> (Illinois), <i>Guernsey Breeders' Journal, The Journal of Agriculture and Horticulture, Successful Farming</i>	388
College and alumni notes.....	390

NUMBER 8, JANUARY, 1929

On the advancement of science. Published Papers.....	395
The corn borer, <i>Pyrausta nubilalis</i> Hübner (Pyralidae, Pyraustinae, Lepidoptera). CATALINO T. BULIGAN.....	397
Studies of the germination of vegetables seeds. GAUDENCIO A. VENTURA.....	451
Note: The eclipse of May 9, 1929.....	465
Abstract: "The relation of rainfall to the production of corn". SEVERINO L. SALVADOR.....	466
Extension Division notes.....	467
Exchange notes from— <i>Science, Commerce Reports</i> (U. S.), <i>The Agricultural Journal of India, California Cultivator, The Prairie Farmer</i> (Illinois), <i>The Journal of the Jamaica Agricultural Society</i>	468
College and alumni notes.....	470

NUMBER 9, FEBRUARY, 1929

A research delusion.....	473
The trend of sexual and reproductive seasons among horses, cattle, water buffaloes, sheep, and goats under Los Baños conditions: A preliminary report. VALENTE VILLEGAS.....	477
Comparative wear of certain metals and alloys used in plows and disk harrows. ALEJANDRO B. CATAMBAY.....	487
A study of certain chemical treatments in relation to seed-borne diseases of Calauan yellow flint maize. VALERIANO C. CALMA, LORENZO G. PADERNA, AND MACARIO A. PALO.....	499
The use of steam in Kjeldahl nitrogen determination. F. T. ADRIANO.....	509
Accuracy in the weighing of experimental chickens. F. M. FRONDA.....	511
Yielding power of peanuts from cuttings of different ages. P. A. RODRIGO.....	519
Sugar cane breeding in the College of Agriculture: V. Isolation of live cane arrows and their use for hybridization. TORIBIO MERCADO.....	527
The effect of dry heat on weevils in corn and on corn seed. ENRIQUE M. PALLER.....	537
A review: "Commercial timber trees of the Malay Peninsula". ADRIANO V. SANTOS....	551
Abstract: "Variability in important agronomical characters among sugar canes from parent varieties H-227, Louisiana striped, Cebu purple, and Badila." JOSÉ O. CRUZ.....	552
Exchange notes from— <i>Science, The Prairie Farmer</i> (Illinois), <i>California Cultivator, Commerce Reports</i> (U. S. A.), <i>Tropical Agriculture</i>	553
College and alumni notes.....	555

NUMBER 10, MARCH, 1929

Agricultural education in the United States.....	557
The Nagoya, a new immigrant from Japan. F. M. FRONDA AND B. M. GONZALEZ....	559
Comparative analysis of American and Philippine cigarettes. V. G. LAVA AND S. B. ETORMA.....	565
A summary of studies on the depth of irrigation water for lowland rice in western Laguna. ALEXANDER GORDON.....	579
A promising cassava grater for the farm. ZOSIMO MONTEMAYOR.....	593
Zacate and water consumption of Philippine horses. VALENTE VILLEGAS.....	599
Effect on young rice plants of adding aluminum salts to complete culture solutions. FELIX VILLA.....	607
A comparative study of the growth and development of kids and milking and non-milking does. LEONCIO LIMPIADO.....	627
Published contributions of the College of Agriculture: VI. B. M. GONZALEZ.....	637

Note: The Baker Memorial Professorship.....	643
Note: The Association of Junior Sugar Technologists. G. GUANZON.....	645
Abstract: "A Fusarium bulb rot of onion." PASCUAL ROBIN.....	647
Exchange notes from—Iowa Agricultural Journal (Iowa), <i>Farming in South Africa</i> , <i>The Fertilizer Review</i> (Washington, D.C.), <i>The Journal of the Jamaica Agricultural Society</i> , <i>The Prairie Farmer</i> , <i>Commerce Reports</i> (U. S.), <i>California Cultivator</i> , <i>The American Florist</i>	647
College and alumni notes.....	650

ERRATA

- Page 21, line 7 from top, "*Lucaena glauca*" should read "*Leucaena glauca*."
- Page 22, line 6 from bottom, "*Impomoea*" should read "*Ipomoea*".
- Page 22, line 17 from bottom "*Artocarpus champeden* Sprng," should read "*Artocarpus champeden* Spreng."
- Page 79, line 10 from bottom, "*Hemilea vastatrix*" should read "*Hemileia vastatrix*".
- Page 79, line 14 from bottom, "*cercospora*" should read "*Cercospora*".
- Page 127, line 6 from bottom "*Pteris qudriaurita*" should read "*Pteris quadriaurita*".
- Page 127, line 10 from top, "*Ampullaris vittata*" should read "*Ampullaria vittata*".
- Page 256, line 1 from top, "*Pseudorphombus*" should read "*Pseudorhombus*".
- Page 258, line 17 from top, "*Sardinella longicops*" should read "*Sardinella longiceps*".
- Page 258, line 13 from bottom, "*Hemipterus*" should read "*Nemipterus*".
- Page 303, line 11 from bottom, "× 1120" should read "× 560".
- Page 316, line 10 from bottom, "Sherbakoff, C. W." should read "Sherbakoff, C. D."
- Page 458, line 16 from top, "Haberblandt" should read "Haberlandt."
- Page 506, line 3 from bottom, "Tisdale, W. B." should read "Tisdale, W. H."
- Page 506, line 15 from bottom, "Holbert, J. B." should read "Holbert, J. R."

VOCATIONAL EDUCATION¹

The problem of vocational education which has attracted increasing attention in the United States since the beginning of the twentieth century is now prominently before Philippine educators. To the layman, just what is meant by this sudden renewed interest in vocational education is not exactly understood. The words ring with a new meaning, for have we not already law schools, medical schools, trade schools, agricultural schools, nurses' training schools, and others which are in effect vocational schools? Must it be that these are inadequate to meet the present needs of society and more are necessary for other vocations, or is it that the present tendencies in our public school system need redirection towards more productive lines?

The advancing needs of society are taking into the schools a large amount of the vocational work that used to be handled in the shops, farm, and other occupational centers. The training of artisans and mechanics is now being assumed more and more by regular and special trade schools. People are also demanding that future farmers be trained in schools. Apparently the product obtained through the apprenticeship system is no longer adequate for the more exacting or perhaps greater needs of present day society. But the vocational school which supplants the shop and the farm as a training ground must prove its worth by demonstrating its ability to produce human products of qualifications superior to those produced by the method they seek to supplant.

The success obtained by specialized schools in the older vocations serves as the guiding light that imparts confidence in the teacher of occupations now gradually being brought under school control. No educated man, for example, will take seriously the physician who did not obtain his training in a medical school, or a lawyer who was not trained in a law school. Yet it was not so many years ago that we depended on men without special training for the service these two professions render us now. We are no longer content to have our sick cared for except by the hands of school trained nurses, and in time we may not wear clothes other than those sewed by "academical cutters."

The problem of the agricultural teacher is by no means an easy one. Even in America, where the greatest effort has been made to establish agricultural schools, it is doubted by many whether they have justified the investment made in them in the training of actual farmers. There seems

¹General contribution from the College of Agriculture No. 204.

to be no question as to the success of the agricultural college in producing scientists, or specialists in some particular activity bearing directly on agriculture, such as entomologists, plant breeders, nutrition men, drainage specialists, marketing specialists, soil and fertilizer experts, and the like. Is it not likely that the knowledge required in agriculture is of such a varied nature, and so much under control of natural phenomena that an individual alone finds himself at a tremendous disadvantage in facing such numerous problems? Perhaps a radical readjustment of the manner of operation of the farm will be necessary in the future wherein the common farmer, like the toiler in a large factory, becomes a mere part in a big organization, capable of performing his allotted task so long as conditions are favorable, and depending to a large extent on the specialist to make conditions favorable for his work. This method of organization is already evident in some states of America wherein there is a well established system of experiment stations, and in occasional planter associations such as the Hawaiian Sugar Planters' Association, entities which look after the greater problems of the farmers they seek to serve.

When this system of farm organization becomes more widely acceptable, then the agricultural schools will have their problems of vocational training circumscribed within limits more in consonance with man's natural limitations.

B. M. GONZALEZ,
Acting Dean, College of Agriculture.

Success means nothing more or less than doing the work you are suited for to the best of your ability. It means getting fitted into your proper place in life's machinery, doing each day's work honestly, living cleanly and thriftily, and trying each day to improve upon the work of the day before.

—*The Kalends* (Williams and Wilkins Co.).

Education is a better safeguard of liberty than a standing army. If we retrench the wages of the schoolmaster, we must raise those of the recruiting sergeant.—EDWARD EVERETT.

—*Journal of Education* (Wisconsin)

A REPORT ON AN AGRICULTURAL INVESTIGATION TRIP TO JAVA, FEDERATED MALAY STATES, AND BORNEO.¹

NEMESIO B. MENDIOLA

*Of the Department of Agronomy
Fellow, International Education Board of New York*

WITH FIVE TEXT FIGURES

I received my appointment as a Fellow of the International Education Board of New York in July, 1926. The Board of Regents of the University of the Philippines granted me permission to accept this fellowship and approved an allowance to come from the funds of the University to be paid to me on the same basis as the allowance given University men who had been appointed fellows of the Rockefeller Foundation.

I sailed from Manila on October 16, 1926, arriving in Zamboanga four days later. While waiting in this town for a steamer by which I could reach Singapore, I visited the San Ramon Penal Farm and important coconut and rubber plantations in Basilan Island. On November 2, I sailed on the *S. S. Marudu* of the Straits Steamship Company for Singapore via Jolo and British Borneo ports. The steamer stayed in Jolo the greater part of a day. This gave me the opportunity of visiting, through the courtesy of Governor Moore, the Inulin Estate, where Hevea rubber trees supposed to be the oldest in Jolo are to be found. The Governor showed me the work which he was doing in planting mango, rubber, and other trees along the provincial road. Ex-governor Agustin Alvarez of Zamboanga took me to the Indanan Farm School in Jolo where the principal, Captain Link, showed me the different phases of the work of this school including the school printing press. The most important cities of British Borneo I visited, from the standpoint of my work, are Sandakan and Jesselton. In Sandakan I met Mr. Juvencio Leaño of our College and several alumni of the Philippine School of Forestry who are all employed by the British North Borneo Government. Mr. Agustin Collado, formerly with the Philippine Bureau of Forestry, was in charge of the Forestry office in Sandakan. He showed me the exhibits in the Forestry Museum and accompanied me to several rubber estates and to the Agricultural Experimental Garden, which is under the supervision of Mr. Leaño. When I arrived in Jesselton, I was met by Mr. Felix Telado, another alumnus of our College, who is in charge of the agricultural extension work of the government in that part of Borneo. With him I called on Doctor Bateson who is the botanist of the British North Borneo Government and visited several rubber estates in this region.

¹Experiment Station contribution No. 527. Received for publication March 23, 1928.

Singapore was reached on November 14 and on the following day, I boarded the *S. S. Tasman* of the Koninklijke Paketvaart Maatschappij, for Java. I arrived in Batavia on November 17. The following morning, I took the train for Buitenzorg, arriving at this city after a little more than one hour's journey. I reported for work at once to Doctor P. J. S. Cramer, director of the General Experiment Station, and to Mr. L. Koch, of the Annual Crops Section of the same Station, who was my immediate sponsor.

On December 7, 1926, Doctor Cramer sent the following communication to Dean Baker in which was outlined the work I was to do while in Java:

Buitenzorg, 7 December, 1926.
 DEAN CHAS. F. BAKER
 College of Agriculture
 LOS BAÑOS—PHILIPPINE ISLANDS

Dear Dean Baker,

Referring to my letter of May 7th, No. 561/26 A.P., I have the pleasure to send you a plan of the subjects Mr. Koch and I thought would be good for Dr. Mendiola to study here.

SUBJECT

1. Organization of the General Experiment Station at Buitenzorg.
2. Working of the Section for plant breeding with annual (Mr. Koch) and perannual crops (Mr. de Veer).
3. Methods now used for breeding rice, corn, cassava and coconuts, including the way to register data.
4. Working of the experiment stations for rubber (Buitenzorg), tobacco (Klaten) and sugar cane (Pasoeroean).

As you will see a large part of the work will have to be done in Buitenzorg, but, as the breeding of tobacco and sugar cane is done in Middle- and East Java, Dr. Mendiola will have to go there to study these subjects.

Though not actually part of the work, I thought a short visit to the Government coffee-breeding-garden at Bangelan (East-Java) would also be very instructive, as this garden is a good example of our commercial seed production of coffee varieties.

With kind regards,

Sincerely yours,

(W.g.) P. J. S. CRAMER,
 Director, General Experiment Sta.,
 Department of Agriculture,
 Industry and Commerce.

At the request of Doctor Cramer, a brief report on my work for the period, November 17 to January 15, was submitted to my advisers on January 15. A copy of this report, I learned subsequently, was forwarded to Dr. H. L. Russell, the Dean of the College of Agriculture at Madison, Wisconsin. Later, I sent a copy to the Director of the European Office of the International Education Board at Paris. Still later, a communication from Dean Baker gave the information that Dean Russell forwarded a copy of the report to the International Education Board Office at New York.

Besides carrying my work in the section under Mr. Koch and in that for perennial crops of the General Experiment Station during the period of my fellowship following January 15, 1927, I did the following:

In April I visited the following Experiment Stations: Sugar Cane Experiment Station at Pasoeroean and its Cane Breeding Garden at Blambangan; the Fruit Extension Garden in Pasoeroean; the Experiment Station for Coffee and Rubber at Malang; the Government Coffee Estate at Bangelan; and the Tobacco Station at Klaten. Still later, I visited the Cinchona Experiment Station at Tjinjiroean and the Exposition at Bandoeng.

Before leaving Java for the Federated Malay States in August, I conferred with the staff of the Experiment Station for Tea and of the Division of Agriculture of the Department of Agriculture, Commerce, and Industry and visited its large fruit garden at Pasar Mingoe.

While waiting for boat connections in Singapore, I visited one of the largest pineapple canneries in that city. In the Federated Malay States I visited the departments of Agriculture and of Forestry in Kuala Lumpur, including the Public Garden and the Experiment Station at Serdang, Langor.

FACILITIES FOR FOREIGN INVESTIGATORS AND DIFFICULTIES THEY MEET

The work of different agricultural experiment stations in Java and Sumatra is bound to attract there an increasing number of technical men from the Philippines. With the thought that they may prove helpful to such visitors I give the following suggestions:

Language preparation. It is not essential that a technical visiting worker in Java have a speaking knowledge of the Dutch language. The Dutch scientists in Java speak English and German and frequently other languages. The men older in the service speak the Malay dialects. These, they are forced to learn, for they have to deal with native subordinates and laborers who do not understand Dutch. Many of the Dutch scientists in Java are graduates of the College of Agriculture at Wageningen, Holland, where, I was informed, English, German, and French are required.

Location of main offices and laboratories. The offices and laboratories of the Department of Agriculture, Commerce, and Industry of the Dutch East Indies are grouped together on a beautiful site at Buitenzorg in and outside the famous Botanical Garden. The hotels are a stone's throw from this place. In fact one of the hotels and the building housing the offices of the Forestry Division stand side by side. The Buitenzorg Railroad Station is just about five minutes walk from the grounds of the Department of Agriculture and of its different divisions.

The private experiment stations, except the offices of the General Rubber Experiment Station and the Station for Tea, are all outside Buitenzorg but all can be reached by railroad trains and motor cars. Only the Coffee Estate of the Government at Bangelan, Residency Pasoeroean, is comparatively difficult to reach. The road leading from the nearest railroad station to this estate may be reached by motor car and it is advised to use a Ford car if one does not want to ride in the equivalent of a Philippine *carretela*.

The train service in Java is excellent and a complete guide book is obtainable at any of the larger stations. A little Malay, such as can be picked up readily, is necessary to avoid misunderstandings with railroad employees and with coolies. One who stays several months and hires servants learns the dialects faster. Many words in the Filipino dialects are found in the Malay as spoken in Java.

The library of the Department of Agriculture. The library of the Department of Agriculture is located near the main offices of the experiment stations. It has 130,000 volumes and receives about 600 different publications. It publishes every year a list of publications received both under subscription or under exchange. A practice worthy of note is that one day each month each technical member of the Department Staff is furnished with available current publications in this line. The librarian sends the list in with the accompanying publications checked to the station member for signature. Then after the latter is through with them he sends them back to the library and the publications are again available for others. In this way one is kept posted quite easily on the current work along his line. The Department of Agriculture has issued a complete list of all its publications for the period ending December, 1926, and this list should prove very useful to one who desires to study the research work in the Netherlands Indies.

Publications in Dutch. The results of investigations and research in the Netherlands Indies are published, generally in the Dutch language, in Holland or in Java. Experimental results of more international importance are sometimes published in English or with English summaries. Still other results are published in German. For extension work some are published in the dialects.

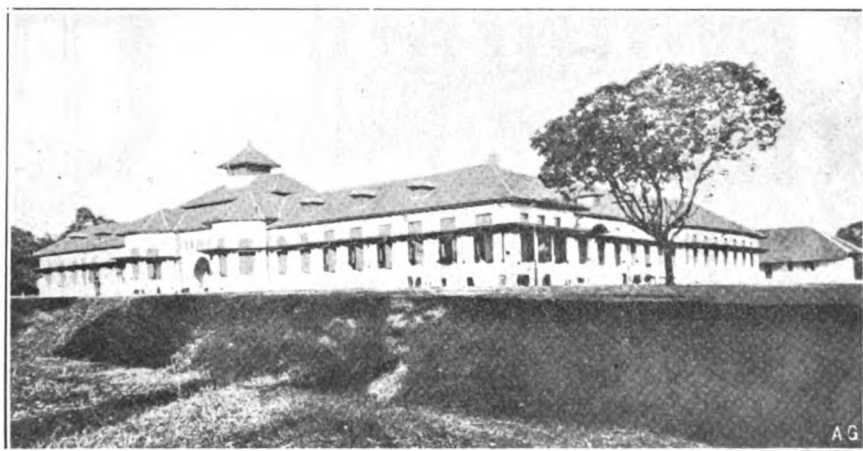
A difficulty which one should be ready to meet in the reading of Dutch literature on agriculture in the Dutch East Indies is the use of dialect words. The Dutch workers are forced to mix a number of dialect words with Dutch words in their publications. A knowledge of the dialect and the possession of a Malay-English dictionary are not complete aids in this difficulty. For these Malay or other dialect words used have been written according to Dutch spelling. For example, *u* is written *oe*; *y*, as *ij*, etc. Consequently, only through the help of the Dutch men familiar with these Dutch-Malay words can a worker understand their meaning. Moreover, verbs have been coined as derivatives of Malay nouns. For example, the Dutch-Malay verb *gepatjoeled* meaning hoed (past participle) is derived from *patjoel* (the native hoe). These words are not italicized, are seldom in quotations (and even when so written it is hard to get their meaning) and are almost never parenthetically defined.

Malay-English dictionaries which are sold in the ordinary bookstores lack the necessary technical qualities, hence, names of plants either are not given or are seldom scientifically correct. Native names of plants and

their corresponding scientific names may be found in K. Heyne's *Nuttige Planten van Nederlandisch Indies*, Parts I to III, preferably the second edition.

THE DEPARTMENT OF AGRICULTURE, INDUSTRY AND COMMERCE

While most of my work in Java was directly in the government experiment stations, I was interested to find out the organic position of the station and its relationship to its sister divisions. The government experiment station, generally known as the General Experiment Station, is under the Department of Agriculture, Commerce, and Industry. This Department contains several divisions for research work. These are a botanical garden, a general agricultural experiment station, a veterinary experiment station, a phytopathological laboratory, and a forestry experiment station.



(Courtesy of Dr. Valetón, Jr.)

Fig. 1.—The main building of the Middle Agricultural School at Buitenzorg, Java.

Besides these divisions for research, the department includes administrative services, such as forestry service, veterinary service, schools for agriculture, a school for veterinary students, and then the Division of Commerce and the Division of Industry. The irrigation work is under the public department while the meteorological work and observatory is a part of the navy department.

The administrative officers of the department are a director, an under-director, and a secretary. The expenses of the Department for the year 1925 totaled 19,555,237 guilders and for 1926, 21,438,642 guilders. (One guilder = 0.82 peso.)

The Extension Service is under the Division of Agriculture and has for its staff, a head, two inspectors, one adjunct inspector, thirty-one agricultural advisers, seventeen middle and lower technical-officers, sixty adjunct agricultural advisers and thirty-four supervisors.

The School of Agriculture (Middlebare Landbouw School) and training of agricultural advisers and adjunct advisers. The object of the middle school for agriculture is to train young men for higher positions in agriculture, mostly for private, but partly also for government work. In academic standing, compared with similar institutions in the Philippines, it is in some respects about midway between the Muñoz Agricultural School and the College of Agriculture at Los Baños. As higher positions in agriculture are available practically only on the estates (*haciendas*), or large plantations or farms, to which most of the graduates go, it is logical to find a good deal of influence of estate owners in the school. For example, the



(Courtesy of Dr. Valetón, Jr.)

Fig. 2.—A group of graduates of the Middle Agricultural School at Buitenzorg shown with the Superintendent of the Moeara Seed Garden. These graduates are spending one year of actual farming on the seed farm preparatory to their entering the extension service of the Department of Agriculture in Java.

board of supervisors consists of five men besides the secretary and four of these five, including the chairman, are either estate administrators or business men. Moreover, agricultural associations and private men have raised funds for the pensioning of students in these schools.

Sons of planters are given preference. Only students who are industrious, fine in bearing, and strong in body may enjoy the pension. After graduation, those who enjoyed the pension are required to pay back by installment the money given to them during their student days. The pension varies according to demand, but in no case does it amount to more than 50 guilders (about 40 pesos) a month.

For positions of sub-agricultural advisers, the Department of Agriculture pensions a certain number of students each year. The pension is about 28 pesos a month. After graduation they are given an additional year of preparation and receive from the government about 100 pesos a month. In this last year of pre-service preparation they are given land in the Moeara Seed Station and are allowed to farm under the supervision of the superintendent of the seed farm. The training is very rigorous, as they have to do all the kinds of work on a farm. They have to rise about five o'clock in the morning to begin each day's work. After this one year of preparation the supervisor classifies them as to suitability for different positions and they are appointed accordingly. They are bound to serve the government five years as adjunct agricultural advisers.

The adjunct agricultural advisers never rise to the position of agricultural advisers (they are called *landbouwconsulenten* in Java). The agricultural advisers always come from Holland and are graduates of the agricultural institutions of that country. After arriving in Java they are required to visit and learn the working of the different divisions and sub-divisions of the Department of Agriculture, particularly of the General Experiment Station. After this they are assigned to their respective provinces.

A point worth mentioning in connection with the agricultural school at Buitenzorg is that the school yards and some of the farm practice grounds are adjacent to the important cultures of the General Experiment Station. They practice with the most important crops of Java,—rice, rubber, coffee, cacao, etc.

The absence of a college of agriculture in Java of full university grade should not be taken to mean that it is not a necessity in the agricultural work in Java. The fact is that men needed in Java for superintendents and executive work are all Dutchmen and come from a college of agriculture in Holland. The graduates of schools of agriculture in Java are never expected to take the positions that are filled by graduates of the colleges of agriculture in Holland.

In addition to the Middle Agricultural School at Buitenzorg, the Department of Agriculture directs two other vocational schools in Java. One of them is in Soekaboemi and is especially suited for training men who go out to work with tea, rubber, and quinine; the other school is in Malang and trains men for coffee and rubber work especially. Both of these schools are lower in grade than the one in Buitenzorg.

THE EXPERIMENT STATIONS

There are in Java both private and government experiment stations. The private stations look after the interests of the agriculture financed with foreign capital. The government stations, the chief one being the General Experiment Station under the directorship of Doctor Cramer, aim at the improvement of native farming.

The following figures give some idea of the yearly appropriations for some of the experiment stations:

Government

Botanical Garden.....	238,593	guilders
General Experiment Station and Institute for Plant Diseases.....	367,129	"
Division of Agriculture.....	794,453	"

Private

Tea Experiment Station.....	100,000	"
(5,000 of which is government subsidy)		
Sugar cane Experiment Station at Pasoeroean.....	1,000,000	"
Kina (cinchona) Experiment Station.....	30,390	"
Tobacco Station at Klaten.....	110,750	"
Experiment Station of coffee and rubber at Malang (6,000 guilders income).....	128,210	"

A bird's eye view of the rôle of these different institutions may be obtained from the following statement by Doctor Cramer:

The organization of research work in agriculture in the Netherlands Indies has followed different lines. Out of a botanical garden with a small scientific staff developed a department of agriculture, industries and commerce, which, as a government institution endeavors to stimulate these branches of human activity and to improve their results.

Large plantation companies have established their own experiment stations which are absolutely independent of government control and support many of the other private stations, like those for rubber and coffee and have also local importance as they help local farmers besides doing research work, sometimes also, private interests combine and raise special funds for the solution of important problems that form a serious menace to their work. Such are the coffee borer funds.

The most significant point to remember about research work in the Netherlands Indies, as Cramer says, is that research work has "adapted itself all the time to the special needs of the moment and of the interest involved."

ORGANIZATION OF THE GENERAL EXPERIMENT STATION AT BUITENZORG

On this subject, I consulted the 1925 and 1926 annuals of the Department of Agriculture, Commerce, and Industry. Mr. Koch gave me later information on the Institute for Plant Diseases, which was not formerly under the General Experiment Station, but is now incorporated with it under the same head.

Through the direct or indirect introductions of my sponsor, I met and obtained valuable information from the following men: Mr. De Veer of the Division of Permanent Crops, Mr. Van der Meer of the Moeara Seed Garden, Mr. Groenewege of the Microbiological Division, Mr. Leefmans, Doctor Van der Goot, Doctor Schwarz, and Doctor Doyer of the Institute for Plant Diseases. My contacts also with the Librarian of the Department, with Doctor Bubberman, Head of the Veterinary Laboratories, and with Doctor Valetton, Director of the Middlebare Landbouw School, as well as with prospective *landbouwconsulenten* (similar to the higher class of the extension agents, in the Philippines), all contributed to the making of my stay in Java very instructive.

The different divisions composing this station are: Laboratory for soil research, chemical laboratory, botany laboratory, and an agricultural division. The last is subdivided into a section for annual crops and another for perennials. As stated above, recently the Institute for Plant Diseases was placed as a division under the General Experiment Station. The Institute is composed mainly of a botany laboratory, zoölogical laboratory, and the section for inspection service.

WORKING OF THE SECTIONS FOR ANNUAL AND PERENNIAL CROPS

My information on this subject is derived not only from the reprints of publications kindly furnished me by Mr. Koch and from his 1925 and 1926 Annual Reports, but from the more important sources of observations made in the fields at Tjikenmeuh and at Moeara, and from occasional explanations made by Mr. Koch. The main divisions of work of the annual crops section are the improvement of rice, maize, cassava, fiber roselle, and peanut; fertilization experiments with rice and other crops; tests and use of various species of cover plants and green manures; the improvement of inland agricultural implements; and the distribution of improved seeds and improved implements, such as the Moeara plow, Moeara hand cultivator, the *katjip*, the *landak*, and the *twin landak*. I brought with me when I returned to the Philippines a model of each of these implements.

The relation of seed raising in the Moeara Seed Garden to the farm work of the prospective *adjunct-landbouwconsulenten* (whose training farms are in Moeara also) and to the system of training of these future *adjunct-landbouwconsulenten* themselves struck me as a possible model for the Philippine Government.

The work in the Section for Perennial Crops on rubber and kapok budding and the grafting of coffee as a means of multiplication of important hybrids and mother plants impressed me greatly.

After studying the method used by Mr. Koch in keeping experimental records, I came to the conclusion that it is many times better than the card or loose leaf system I have been using in the Philippines, and so I have adopted it with a little modification.

I had the privilege of taking an active part in the work of actual inbreeding of corn and selection of desirable maize strains and in the selection of rice seedlings. I also saw the rice plants being inbred, with the inbreeding bags still on, before the panicles were harvested. I also observed the methods of seed bed preparation, seed sowing, uprooting of the seedlings, and transplanting, in the rice work. The cassava plants were not in flower and hence there was no self-pollination work with this plant at that time. However, I studied the published results of cassava breeding including a tabulated system of identifying the varieties now growing in this section. As many of the cassava varieties we have in the Philippines came from this Station, this method of classification of cassava varieties will be very use-

- SANTOS, F. O., AND E. G. COLLADO. The anti-beriberi vitamin content of sweet potato leaves and shoots, 513
- SARAO, FELIX B., *see* VILLEGAS, VALENTE AND FELIX B. SARAO.
- Science as culture (reprinted), 279
- Siam, area devoted to rice in, 55
- Sheep in Japan, 290
- SHERMAN, H. C., AND S. S. SMITH, cited, 513
- SHIMAZONO, J., cited, 515
- SHOUP, GEO. R., cited, 43
- SOLIVEN, FLORENCIO
cited, 587
- The seed and oil of *Jatropha curcas*, 587
- Soybeans, as subsidiary farm crop, 68
- Soybean, uses of, 565
- Students and graduates of the College of Agriculture by years, 161
- Sugar cane leaf-hopper, 397
- SUMAGIT, F. S., cited, 543
- Summary of the present occupations of the graduates of the College of Agriculture, 160
- SUMNER, F., cited, 90
- Sunflower family, genera and species of, 390
- SWARTHOUT, A. V., cited, 33
- Sweet potatoes
anti-beriberi vitamin content of, 513
secondary crop of Japan, 68
- Swine, in Japan, 288

T

- Tanning, some experiments on farm, 253
- TAVERNETTI, THOMAS. What advice shall we give to our graduates? (reprinted), 569
- Tenancy in Zambales, 374
- TERUEL, EUSEBIO, cited, 298
- TIDEN, H., cited, 90
- The new man at the helm, 277
- Then . . . Now, 178
- The possibilities of cassava production in the Philippines, 433
- The relation between the tensile strength of an abacá fiber and the length of the individual cells composing it, 441
- The sugar cane leaf-hopper *Perkinsiella vastatrix* Breddin (Delphacidae, Homoptera), 397

Tobacco

- co-operative marketing in Cagayan, progress of, 341
- curing of, 538
- Growers' Association Inc.
a study of, 19
- community curing sheds of, 25
- In Ilagan, Isabela, a study of the cost of production and distribution of income of, 495
- Tuguegarao, Cagayan, 19, 341

U

- URBINO, CORNELIO M. The sugar cane leaf-hopper, *Perkinsiella vastatrix* Breddin (Delphacidae, Homoptera), 397

V

- VEDDER, E. B., cited, 516
- VEDDER, E. B., AND E. CLARK, cited, 514
- VELMONTE, JOSÉ E. American and foreign capital acquisitions of the Philippine public domain, 603
- Veterinary supplies, 585
- VILLEGAS, VALENTE
Cattle raising under Philippine conditions, 571
- AND F. B. SARAO. Observations on range cattle at the Hacienda del Rosario, Cainta, Rizal, 391

W

- WALKER, H. G., cited, 461
- "Wealth awaits you on the farm," 58
- What advice shall we give to our graduates (reprinted), 569
- WINSHIP, E. A., Great farmers (reprinted), 557
- WITHYCOMBE, J., cited, 35
- What are your answers—yes or no (reprinted), 279
- What they say about Mendiola's book, 181
- World's farmers get together, 65

Z

- Zambales, tenancy in the municipality of San Felipe *abstract* by FRANCISCO M. SACAY, 374

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(Complete in ten numbers)

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CONTENTS

VOLUME XVII

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NUMBER 1, JUNE, 1928

Vocational education. B. M. GONZALEZ.....	1
A report on an agricultural investigation trip to Java, Federated Malay States, and Borneo. N. B. MENDIOLA.....	3
The seasonal distribution of egg production: The normal egg production curve. F. M. FRONDA.....	25
Comparative nutritive values of different salts of ammonium. ELEUTERIO PALISOC...	37
Note: Introduced coffees lose resistance to <i>Hemileia vastatrix</i> Berkeley and Broome. PEDRO A. DAVID.....	45
Extension Division notes.....	51
Exchange notes from— <i>Butter, Cheese and Egg Journal</i> (Wisconsin), <i>Capper's Farmer</i> (Kansas), <i>Journal of Education</i> (Wisconsin), <i>The Journal of Agriculture</i> (Australia), <i>Journal of Agriculture</i> (New Zealand), <i>Agricultural Gazette</i> (New South Wales), <i>The</i> <i>American Review of Reviews</i> (New York), <i>Prairie Farmer</i> (Illinois).....	53
College and alumni notes.....	55

NUMBER 2, JULY, 1928

What a University should do for its students.....	59
Practical directions for coffee planting. PEDRO A. DAVID.....	65
Studies on the correlation between the seed and straw production of some field legumes. P. A. RODRIGO.....	83
Report on recuperative growths within a year of some plants injured by a typhoon. RAFAEL B. ESPINO.....	89
A comparative study of the effect of copra meal and dried shrimps as supplement in rations for laying hens. JOSÉ A. SERRANO.....	95
A comparative study of corn and cassava as feeds for hogs: II. Ground corn vs. raw chopped cassava. MARIANO MONDOSEDO.....	105
The Baker Memorial Fund.....	109
Extension Division notes.....	110
Exchange notes from— <i>Butter, Cheese and Egg Journal</i> (Wisconsin), <i>Tropical Agriculture</i> , <i>Journal of Agriculture</i> (Victoria), <i>Capper's Farmer</i> (Kansas), <i>California Cultivator</i> , <i>Tropical Life</i> , <i>The Australian Sugar Journal</i> , <i>Queensland Agricultural Journal</i>	111
College and alumni notes.....	113

NUMBER 3, AUGUST, 1928

Co-operation. C. F. BAKER.....	115
The measure of a man.....	116
A gravity gate, or simple self-closing gate. ALEXANDER GORDON.....	117
Proximate analysis of some Philippine shellfish. SEVERINO B. ETORMA.....	125
The culture and cost of barit in Bay, Laguna. RAMON C. ORDOVEZA.....	137
The composition of commercial sugar from Philippine centrals. DELFIN J. SUERTE...	149
Note: Production of <i>Pyrethrum</i> flowers in Japan.....	153
Extension Division notes.....	154
Exchange Notes from— <i>The Planter and Sugar Manufacturer</i> , <i>The American Review of</i> <i>Reviews</i> (New York), <i>Industrial Bulletin</i> of ARTHUR D. LITTLE, Inc., <i>Prairie Farmer</i> (Illinois).....	156
College and alumni notes.....	158

NUMBER 4, SEPTEMBER, 1928

Some possibilities in breeding plants used for cover, green manure, and shade. NEMESIO B. MENDIOLA.....	159
Chemical studies on coconut products: II. Utilization of the coconut. N. GALVEZ, R. MORENO, AND V. G. LAVA.....	163
Pathological lesions caused by an undescribed <i>Cooperia</i> in a carabao. A. K. GOMEZ.	169
Effects upon rice plants of changing the moisture content of soil. FELICIANO T. PANTALEON.....	173
Plowing under legumes by the use of single-animal plows. CHARAS S. SUNDARASINHA....	187
Doctor Manuel L. Roxas: An appreciation. B. M. GONZALEZ.....	197
Note: The Baker collection.....	199
A review: "Practical Poultry Farming". F. M. FRONDA.....	201
Extension Division notes.....	203
Exchange notes from— <i>California Cultivator</i> , <i>Journal of Agriculture</i> (Victoria), <i>The Prairie Farmer</i> (Illinois), <i>Poona Agricultural College Magazine</i> (India), <i>American Poultry Journal</i> , <i>The Planter and Sugar Manufacturer</i>	208
College and alumni notes.....	209

NUMBER 5, OCTOBER, 1928

Short course in agriculture.....	211
The Japanese Imperial Government Institute for Nutrition. F. O. SANTOS.....	215
Gray spot, or blight, of coconut. FELIPE CORTEZ.....	223
A study of the feeding, care, and management of native calesa horses at Los Baños, Laguna. ANTERO P. INCIONG.....	243
The chemical composition of Philippine fishes. AMADO N. BALAGTAS.....	253
Notes on an outbreak of poultry epidemic. FRANCISCO GO KEE, M.D.....	263
Extension Division notes.....	267
Exchange notes from— <i>Butter and Cheese Journal</i> , <i>The Prairie Farmer</i> (Illinois), <i>Science</i> , <i>Tropical Life</i> , <i>The Iowa Agriculturist</i> (Iowa State College), <i>Commerce Reports</i> (U. S. A.) <i>Agricultural Gazette</i> (N. S. W.).....	269
College and alumni notes.....	271

NUMBER 6, NOVEMBER, 1928

Vocational teachers of agriculture in North Carolina.....	275
A report on the asexual inheritance of "many-eyed" character of sugar cane. TORIBIO MERCADO.....	277
Our farm labor supply. PABLO N. MABBUN.....	287
A <i>Fusarium</i> causing bulb rot of onion in the Philippines. MACARIO A. PALO.....	301
Notes on yield of some species of coffee grown on the College farm. JOSÉ C. RAMOS.....	317
A word of comment on Gordon's gravity gate. MANUEL A. ROA.....	319
Abstract: "Corn production as affected by some common manures". FELIX N. CAMBA.....	323
Note: "Preparation of scientific and technical papers".....	324
Extension Division notes.....	325
Exchange notes from— <i>Capper's Farmer</i> , <i>Science</i> , <i>California Cultivator</i> , <i>The Agricultural Gazette of N. S. W.</i>	327
College and alumni notes.....	329

NUMBER 7, DECEMBER, 1928

The main business of science.....	331
Third list of cyanophoric plants of Maquiling region. FERNANDO DE PERALTA.....	333
The behavior of antimony electrode in buffered and unbuffered solutions. V. G. LAVA AND E. D. HEMEDES.....	337
Philippine farmers' tax guide. JOSÉ E. VELMONTE.....	351
A study on the growth of coconut. J. BUENO F. FANDINO.....	361
A study on the preparation of hog ration as related to growth and development of pigs. SALVADOR F. BOLIVAR.....	367
Some notes on the Fourth International Congress of Entomology. FRANCISCO M. SACAY..	381

Abstract: "The effect of borders in farm crops experiment". CLEMENTE E. YANGO...	385
Extension Division notes.....	386
Exchange notes from— <i>Science, The Agricultural Gazette of N. S. W., Commerce Reports</i> (U. S. A.), <i>The Farmer and Stockman, Butter and Cheese Journal, The Prairie Farmer</i> (Illinois), <i>Guernsey Breeders' Journal, The Journal of Agriculture and Horticulture, Successful Farming</i>	388
College and alumni notes.....	390

NUMBER 8, JANUARY, 1929

On the advancement of science. Published Papers.....	395
The corn borer, <i>Pyrausta nubilalis</i> Hübner (Pyralidae, Pyraustinae, Lepidoptera). CATALINO T. BULIGAN.....	397
Studies of the germination of vegetables seeds. GAUDENCIO A. VENTURA.....	451
Note: The eclipse of May 9, 1929.....	465
Abstract: "The relation of rainfall to the production of corn". SEVERINO L. SALVADOR.....	466
Extension Division notes.....	467
Exchange notes from— <i>Science, Commerce Reports</i> (U. S.), <i>The Agricultural Journal of India, California Cultivator, The Prairie Farmer</i> (Illinois), <i>The Journal of the Jamaica Agricultural Society</i>	468
College and alumni notes.....	470

NUMBER 9, FEBRUARY, 1929

A research delusion.....	473
The trend of sexual and reproductive seasons among horses, cattle, water buffaloes, sheep, and goats under Los Baños conditions: A preliminary report. VALENTE VILLEGAS.....	477
Comparative wear of certain metals and alloys used in plows and disk harrows. ALEJANDRO B. CATAMBAY.....	487
A study of certain chemical treatments in relation to seed-borne diseases of Calauan yellow flint maize. VALERIANO C. CALMA, LORENZO G. PADERNA, AND MACARIO A. PALO.....	499
The use of steam in Kjeldahl nitrogen determination. F. T. ADRIANO.....	509
Accuracy in the weighing of experimental chickens. F. M. FRONDA.....	511
Yielding power of peanuts from cuttings of different ages. P. A. RODRIGO.....	519
Sugar cane breeding in the College of Agriculture: V. Isolation of live cane arrows and their use for hybridization. TORIBIO MERCADO.....	527
The effect of dry heat on weevils in corn and on corn seed. ENRIQUE M. PALLER.....	537
A review: "Commercial timber trees of the Malay Peninsula". ADRIANO V. SANTOS....	551
Abstract: "Variability in important agronomical characters among sugar canes from parent varieties H-227, Louisiana striped, Cebu purple, and Badila." JOSÉ O. CRUZ.....	552
Exchange notes from— <i>Science, The Prairie Farmer</i> (Illinois), <i>California Cultivator, Commerce Reports</i> (U. S. A.), <i>Tropical Agriculture</i>	553
College and alumni notes.....	555

NUMBER 10, MARCH, 1929

Agricultural education in the United States.....	557
The Nagoya, a new immigrant from Japan. F. M. FRONDA AND B. M. GONZALEZ....	559
Comparative analysis of American and Philippine cigarettes. V. G. LAVA AND S. B. ETORMA.....	565
A summary of studies on the depth of irrigation water for lowland rice in western Laguna. ALEXANDER GORDON.....	579
A promising cassava grater for the farm. ZOSIMO MONTEMAYOR.....	593
Zacate and water consumption of Philippine horses. VALENTE VILLEGAS.....	599
Effect on young rice plants of adding aluminum salts to complete culture solutions. FELIX VILLA.....	607
A comparative study of the growth and development of kids and milking and non-milking does. LEONCIO LIMPIADO.....	627
Published contributions of the College of Agriculture: VI. B. M. GONZALEZ.....	637

Note: The Baker Memorial Professorship.....	643
Note: The Association of Junior Sugar Technologists. G. GUANZON.....	645
Abstract: "A Fusarium bulb rot of onion." PASCUAL ROBIN.....	647
Exchange notes from—Iowa Agricultural Journal (Iowa), <i>Farming in South Africa</i> , <i>The Fertilizer Review</i> (Washington, D.C), <i>The Journal of the Jamaica Agricultural Society</i> , <i>The Prairie Farmer</i> , <i>Commerce Reports</i> (U. S.), <i>California Cultivator</i> , <i>The American Florist</i>	647
College and alumni notes.....	650

ERRATA

- Page 21, line 7 from top, "*Lucaena glauca*" should read "*Leucaena glauca*."
- Page 22, line 6 from bottom, "*Impomoea*" should read "*Ipomoea*".
- Page 22, line 17 from bottom "*Artocarpus champeden* Srpeng," should read "*Artocarpus champeden* Spreng."
- Page 79, line 10 from bottom, "*Hemilea vastatrix*" should read "*Hemileia vastatrix*".
- Page 79, line 14 from bottom, "*cercospora*" should read "*Cercospora*".
- Page 127, line 6 from bottom "*Pteris qudriaurita*" should read "*Pteris quadriaurita*".
- Page 127, line 10 from top, "*Ampullaris vittata*" should read "*Ampullaria vittata*".
- Page 256, line 1 from top, "*Pseudorphombus*" should read "*Pseudorhombus*".
- Page 258, line 17 from top, "*Sardinella longicops*" should read "*Sardinella longiceps*".
- Page 258, line 13 from bottom, "*Hemipterus*" should read "*Nemipterus*".
- Page 303, line 11 from bottom, "× 1120" should read "× 560".
- Page 316, line 10 from bottom, "Sherbakoff, C. W." should read "Sherbakoff, C. D."
- Page 458, line 16 from top, "Haberblandt" should read "Haberlandt."
- Page 506, line 3 from bottom, "Tisdale, W. B." should read "Tisdale, W. H."
- Page 506, line 15 from bottom, "Holbert, J. B." should read "Holbert, J. R."

VOCATIONAL EDUCATION¹

The problem of vocational education which has attracted increasing attention in the United States since the beginning of the twentieth century is now prominently before Philippine educators. To the layman, just what is meant by this sudden renewed interest in vocational education is not exactly understood. The words ring with a new meaning, for have we not already law schools, medical schools, trade schools, agricultural schools, nurses' training schools, and others which are in effect vocational schools? Must it be that these are inadequate to meet the present needs of society and more are necessary for other vocations, or is it that the present tendencies in our public school system need redirection towards more productive lines?

The advancing needs of society are taking into the schools a large amount of the vocational work that used to be handled in the shops, farm, and other occupational centers. The training of artisans and mechanics is now being assumed more and more by regular and special trade schools. People are also demanding that future farmers be trained in schools. Apparently the product obtained through the apprenticeship system is no longer adequate for the more exacting or perhaps greater needs of present day society. But the vocational school which supplants the shop and the farm as a training ground must prove its worth by demonstrating its ability to produce human products of qualifications superior to those produced by the method they seek to supplant.

The success obtained by specialized schools in the older vocations serves as the guiding light that imparts confidence in the teacher of occupations now gradually being brought under school control. No educated man, for example, will take seriously the physician who did not obtain his training in a medical school, or a lawyer who was not trained in a law school. Yet it was not so many years ago that we depended on men without special training for the service these two professions render us now. We are no longer content to have our sick cared for except by the hands of school trained nurses, and in time we may not wear clothes other than those sewed by "academical cutters."

The problem of the agricultural teacher is by no means an easy one. Even in America, where the greatest effort has been made to establish agricultural schools, it is doubted by many whether they have justified the investment made in them in the training of actual farmers. There seems

¹General contribution from the College of Agriculture No. 204.

to be no question as to the success of the agricultural college in producing scientists, or specialists in some particular activity bearing directly on agriculture, such as entomologists, plant breeders, nutrition men, drainage specialists, marketing specialists, soil and fertilizer experts, and the like. Is it not likely that the knowledge required in agriculture is of such a varied nature, and so much under control of natural phenomena that an individual alone finds himself at a tremendous disadvantage in facing such numerous problems? Perhaps a radical readjustment of the manner of operation of the farm will be necessary in the future wherein the common farmer, like the toiler in a large factory, becomes a mere part in a big organization, capable of performing his allotted task so long as conditions are favorable, and depending to a large extent on the specialist to make conditions favorable for his work. This method of organization is already evident in some states of America wherein there is a well established system of experiment stations, and in occasional planter associations such as the Hawaiian Sugar Planters' Association, entities which look after the greater problems of the farmers they seek to serve.

When this system of farm organization becomes more widely acceptable, then the agricultural schools will have their problems of vocational training circumscribed within limits more in consonance with man's natural limitations.

B. M. GONZALEZ,
Acting Dean, College of Agriculture.

Success means nothing more or less than doing the work you are suited for to the best of your ability. It means getting fitted into your proper place in life's machinery, doing each day's work honestly, living cleanly and thriftily, and trying each day to improve upon the work of the day before.

—*The Kalends* (Williams and Wilkins Co.).

Education is a better safeguard of liberty than a standing army. If we retrench the wages of the schoolmaster, we must raise those of the recruiting sergeant.—EDWARD EVERETT.

—*Journal of Education* (Wisconsin)

A REPORT ON AN AGRICULTURAL INVESTIGATION TRIP TO JAVA, FEDERATED MALAY STATES, AND BORNEO.¹

NEMESIO B. MENDIOLA

*Of the Department of Agronomy
Fellow, International Education Board of New York*

WITH FIVE TEXT FIGURES

I received my appointment as a Fellow of the International Education Board of New York in July, 1926. The Board of Regents of the University of the Philippines granted me permission to accept this fellowship and approved an allowance to come from the funds of the University to be paid to me on the same basis as the allowance given University men who had been appointed fellows of the Rockefeller Foundation.

I sailed from Manila on October 16, 1926, arriving in Zamboanga four days later. While waiting in this town for a steamer by which I could reach Singapore, I visited the San Ramon Penal Farm and important coconut and rubber plantations in Basilan Island. On November 2, I sailed on the *S. S. Marudu* of the Straits Steamship Company for Singapore via Jolo and British Borneo ports. The steamer stayed in Jolo the greater part of a day. This gave me the opportunity of visiting, through the courtesy of Governor Moore, the Inulin Estate, where Hevea rubber trees supposed to be the oldest in Jolo are to be found. The Governor showed me the work which he was doing in planting mango, rubber, and other trees along the provincial road. Ex-governor Agustin Alvarez of Zamboanga took me to the Indanan Farm School in Jolo where the principal, Captain Link, showed me the different phases of the work of this school including the school printing press. The most important cities of British Borneo I visited, from the standpoint of my work, are Sandakan and Jesselton. In Sandakan I met Mr. Juvencio Leaño of our College and several alumni of the Philippine School of Forestry who are all employed by the British North Borneo Government. Mr. Agustin Collado, formerly with the Philippine Bureau of Forestry, was in charge of the Forestry office in Sandakan. He showed me the exhibits in the Forestry Museum and accompanied me to several rubber estates and to the Agricultural Experimental Garden, which is under the supervision of Mr. Leaño. When I arrived in Jesselton, I was met by Mr. Felix Telado, another alumnus of our College, who is in charge of the agricultural extension work of the government in that part of Borneo. With him I called on Doctor Bateson who is the botanist of the British North Borneo Government and visited several rubber estates in this region.

¹Experiment Station contribution No. 527. Received for publication March 23, 1928.

Singapore was reached on November 14 and on the following day, I boarded the *S. S. Tasman* of the Koninklijke Paketvaart Maatschappij, for Java. I arrived in Batavia on November 17. The following morning, I took the train for Buitenzorg, arriving at this city after a little more than one hour's journey. I reported for work at once to Doctor P. J. S. Cramer, director of the General Experiment Station, and to Mr. L. Koch, of the Annual Crops Section of the same Station, who was my immediate sponsor.

On December 7, 1926, Doctor Cramer sent the following communication to Dean Baker in which was outlined the work I was to do while in Java:

Buitenzorg, 7 December, 1926.
DEAN CHAS. F. BAKER
College of Agriculture
LOS BAÑOS—PHILIPPINE ISLANDS

Dear Dean Baker,

Referring to my letter of May 7th, No. 561/26 A.P., I have the pleasure to send you a plan of the subjects Mr. Koch and I thought would be good for Dr. Mendiola to study here.

SUBJECT

1. Organization of the General Experiment Station at Buitenzorg.
2. Working of the Section for plant breeding with annual (Mr. Koch) and perannual crops (Mr. de Veer).
3. Methods now used for breeding rice, corn, cassava and coconuts, including the way to register data.
4. Working of the experiment stations for rubber (Buitenzorg), tobacco (Klaten) and sugar cane (Pasoeroean).

As you will see a large part of the work will have to be done in Buitenzorg, but, as the breeding of tobacco and sugar cane is done in Middle- and East Java, Dr. Mendiola will have to go there to study these subjects.

Though not actually part of the work, I thought a short visit to the Government coffee-breeding-garden at Bangelan (East-Java) would also be very instructive, as this garden is a good example of our commercial seed production of coffee varieties.

With kind regards,

Sincerely yours,

(W.g.) P. J. S. CRAMER,
Director, General Experiment Sta.,
Department of Agriculture,
Industry and Commerce.

At the request of Doctor Cramer, a brief report on my work for the period, November 17 to January 15, was submitted to my advisers on January 15. A copy of this report, I learned subsequently, was forwarded to Dr. H. L. Russell, the Dean of the College of Agriculture at Madison, Wisconsin. Later, I sent a copy to the Director of the European Office of the International Education Board at Paris. Still later, a communication from Dean Baker gave the information that Dean Russell forwarded a copy of the report to the International Education Board Office at New York.

Besides carrying my work in the section under Mr. Koch and in that for perennial crops of the General Experiment Station during the period of my fellowship following January 15, 1927, I did the following:

In April I visited the following Experiment Stations: Sugar Cane Experiment Station at Pasoeroean and its Cane Breeding Garden at Blambangan; the Fruit Extension Garden in Pasoeroean; the Experiment Station for Coffee and Rubber at Malang; the Government Coffee Estate at Bangelan; and the Tobacco Station at Klaten. Still later, I visited the Cinchona Experiment Station at Tjinjiroean and the Exposition at Bandoeng.

Before leaving Java for the Federated Malay States in August, I conferred with the staff of the Experiment Station for Tea and of the Division of Agriculture of the Department of Agriculture, Commerce, and Industry and visited its large fruit garden at Pasar Mingoe.

While waiting for boat connections in Singapore, I visited one of the largest pineapple canneries in that city. In the Federated Malay States I visited the departments of Agriculture and of Forestry in Kuala Lumpur, including the Public Garden and the Experiment Station at Serdang, Langor.

FACILITIES FOR FOREIGN INVESTIGATORS AND DIFFICULTIES THEY MEET

The work of different agricultural experiment stations in Java and Sumatra is bound to attract there an increasing number of technical men from the Philippines. With the thought that they may prove helpful to such visitors I give the following suggestions:

Language preparation. It is not essential that a technical visiting worker in Java have a speaking knowledge of the Dutch language. The Dutch scientists in Java speak English and German and frequently other languages. The men older in the service speak the Malay dialects. These, they are forced to learn, for they have to deal with native subordinates and laborers who do not understand Dutch. Many of the Dutch scientists in Java are graduates of the College of Agriculture at Wageningen, Holland, where, I was informed, English, German, and French are required.

Location of main offices and laboratories. The offices and laboratories of the Department of Agriculture, Commerce, and Industry of the Dutch East Indies are grouped together on a beautiful site at Buitenzorg in and outside the famous Botanical Garden. The hotels are a stone's throw from this place. In fact one of the hotels and the building housing the offices of the Forestry Division stand side by side. The Buitenzorg Railroad Station is just about five minutes walk from the grounds of the Department of Agriculture and of its different divisions.

The private experiment stations, except the offices of the General Rubber Experiment Station and the Station for Tea, are all outside Buitenzorg but all can be reached by railroad trains and motor cars. Only the Coffee Estate of the Government at Bangelan, Residency Pasoeroean, is comparatively difficult to reach. The road leading from the nearest railroad station to this estate may be reached by motor car and it is advised to use a Ford car if one does not want to ride in the equivalent of a Philippine *carretela*.

The train service in Java is excellent and a complete guide book is obtainable at any of the larger stations. A little Malay, such as can be picked up readily, is necessary to avoid misunderstandings with railroad employees and with coolies. One who stays several months and hires servants learns the dialects faster. Many words in the Filipino dialects are found in the Malay as spoken in Java.

The library of the Department of Agriculture. The library of the Department of Agriculture is located near the main offices of the experiment stations. It has 130,000 volumes and receives about 600 different publications. It publishes every year a list of publications received both under subscription or under exchange. A practice worthy of note is that one day each month each technical member of the Department Staff is furnished with available current publications in this line. The librarian sends the list in with the accompanying publications checked to the station member for signature. Then after the latter is through with them he sends them back to the library and the publications are again available for others. In this way one is kept posted quite easily on the current work along his line. The Department of Agriculture has issued a complete list of all its publications for the period ending December, 1926, and this list should prove very useful to one who desires to study the research work in the Netherlands Indies.

Publications in Dutch. The results of investigations and research in the Netherlands Indies are published, generally in the Dutch language, in Holland or in Java. Experimental results of more international importance are sometimes published in English or with English summaries. Still other results are published in German. For extension work some are published in the dialects.

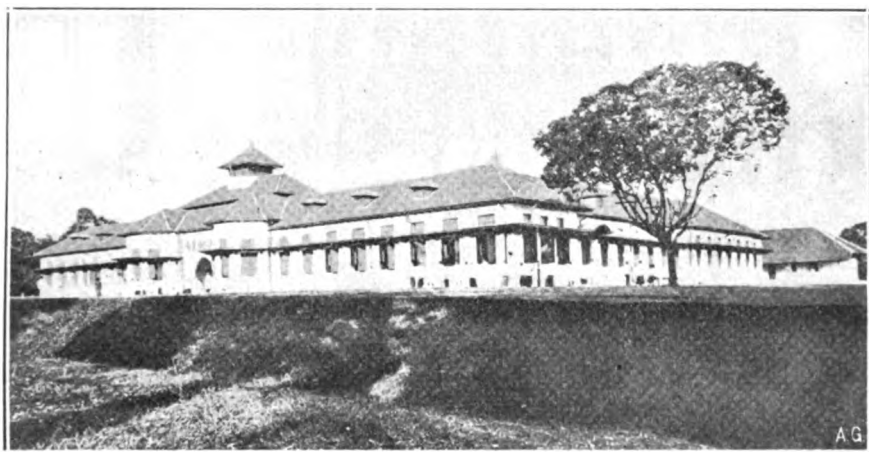
A difficulty which one should be ready to meet in the reading of Dutch literature on agriculture in the Dutch East Indies is the use of dialect words. The Dutch workers are forced to mix a number of dialect words with Dutch words in their publications. A knowledge of the dialect and the possession of a Malay-English dictionary are not complete aids in this difficulty. For these Malay or other dialect words used have been written according to Dutch spelling. For example, *u* is written *oe*; *y*, as *ij*, etc. Consequently, only through the help of the Dutch men familiar with these Dutch-Malay words can a worker understand their meaning. Moreover, verbs have been coined as derivatives of Malay nouns. For example, the Dutch-Malay verb *gepatjoeled* meaning hoed (past participle) is derived from *patjoel* (the native hoe). These words are not italicized, are seldom in quotations (and even when so written it is hard to get their meaning) and are almost never parenthetically defined.

Malay-English dictionaries which are sold in the ordinary bookstores lack the necessary technical qualities, hence, names of plants either are not given or are seldom scientifically correct. Native names of plants and

their corresponding scientific names may be found in K. Heyne's *Nuttige Planten van Nederlandisch Indies*, Parts I to III, preferably the second edition.

THE DEPARTMENT OF AGRICULTURE, INDUSTRY AND COMMERCE

While most of my work in Java was directly in the government experiment stations, I was interested to find out the organic position of the station and its relationship to its sister divisions. The government experiment station, generally known as the General Experiment Station, is under the Department of Agriculture, Commerce, and Industry. This Department contains several divisions for research work. These are a botanical garden, a general agricultural experiment station, a veterinary experiment station, a phytopathological laboratory, and a forestry experiment station.



(Courtesy of Dr. Valetton, Jr.)

Fig. 1.—The main building of the Middle Agricultural School at Buitenzorg, Java.

Besides these divisions for research, the department includes administrative services, such as forestry service, veterinary service, schools for agriculture, a school for veterinary students, and then the Division of Commerce and the Division of Industry. The irrigation work is under the public department while the meteorological work and observatory is a part of the navy department.

The administrative officers of the department are a director, an under-director, and a secretary. The expenses of the Department for the year 1925 totaled 19,555,237 guilders and for 1926, 21,438,642 guilders. (One guilder = 0.82 peso.)

The Extension Service is under the Division of Agriculture and has for its staff, a head, two inspectors, one adjunct inspector, thirty-one agricultural advisers, seventeen middle and lower technical-officers, sixty adjunct agricultural advisers and thirty-four supervisors.

The School of Agriculture (Middlebare Landbouw School) and training of agricultural advisers and adjunct advisers. The object of the middle school for agriculture is to train young men for higher positions in agriculture, mostly for private, but partly also for government work. In academic standing, compared with similar institutions in the Philippines, it is in some respects about midway between the Muñoz Agricultural School and the College of Agriculture at Los Baños. As higher positions in agriculture are available practically only on the estates (*haciendas*), or large plantations or farms, to which most of the graduates go, it is logical to find a good deal of influence of estate owners in the school. For example, the



(Courtesy of Dr. Valetón, Jr.)

Fig. 2.—A group of graduates of the Middle Agricultural School at Buitenzorg shown with the Superintendent of the Moeara Seed Garden. These graduates are spending one year of actual farming on the seed farm preparatory to their entering the extension service of the Department of Agriculture in Java.

board of supervisors consists of five men besides the secretary and four of these five, including the chairman, are either estate administrators or business men. Moreover, agricultural associations and private men have raised funds for the pensioning of students in these schools.

Sons of planters are given preference. Only students who are industrious, fine in bearing, and strong in body may enjoy the pension. After graduation, those who enjoyed the pension are required to pay back by installment the money given to them during their student days. The pension varies according to demand, but in no case does it amount to more than 50 guilders (about 40 pesos) a month.

For positions of sub-agricultural advisers, the Department of Agriculture pensions a certain number of students each year. The pension is about 28 pesos a month. After graduation they are given an additional year of preparation and receive from the government about 100 pesos a month. In this last year of pre-service preparation they are given land in the Moeara Seed Station and are allowed to farm under the supervision of the superintendent of the seed farm. The training is very rigorous, as they have to do all the kinds of work on a farm. They have to rise about five o'clock in the morning to begin each day's work. After this one year of preparation the supervisor classifies them as to suitability for different positions and they are appointed accordingly. They are bound to serve the government five years as adjunct agricultural advisers.

The adjunct agricultural advisers never rise to the position of agricultural advisers (they are called *landbouwconsulenten* in Java). The agricultural advisers always come from Holland and are graduates of the agricultural institutions of that country. After arriving in Java they are required to visit and learn the working of the different divisions and sub-divisions of the Department of Agriculture, particularly of the General Experiment Station. After this they are assigned to their respective provinces.

A point worth mentioning in connection with the agricultural school at Buitenzorg is that the school yards and some of the farm practice grounds are adjacent to the important cultures of the General Experiment Station. They practice with the most important crops of Java,—rice, rubber, coffee, cacao, etc.

The absence of a college of agriculture in Java of full university grade should not be taken to mean that it is not a necessity in the agricultural work in Java. The fact is that men needed in Java for superintendents and executive work are all Dutchmen and come from a college of agriculture in Holland. The graduates of schools of agriculture in Java are never expected to take the positions that are filled by graduates of the colleges of agriculture in Holland.

In addition to the Middle Agricultural School at Buitenzorg, the Department of Agriculture directs two other vocational schools in Java. One of them is in Soekaboemi and is especially suited for training men who go out to work with tea, rubber, and quinine; the other school is in Malang and trains men for coffee and rubber work especially. Both of these schools are lower in grade than the one in Buitenzorg.

THE EXPERIMENT STATIONS

There are in Java both private and government experiment stations. The private stations look after the interests of the agriculture financed with foreign capital. The government stations, the chief one being the General Experiment Station under the directorship of Doctor Cramer, aim at the improvement of native farming.

The following figures give some idea of the yearly appropriations for some of the experiment stations:

Government

Botanical Garden.....	238,593	guilders
General Experiment Station and Institute for Plant Diseases.....	367,129	"
Division of Agriculture.....	794,453	"

Private

Tea Experiment Station.....	100,000	"
(5,000 of which is government subsidy)		
Sugar cane Experiment Station at Pasoeroean.....	1,000,000	"
Kina (cinchona) Experiment Station.....	30,390	"
Tobacco Station at Klaten.....	110,750	"
Experiment Station of coffee and rubber at Malang (6,000 guilders income).....	128,210	"

A bird's eye view of the rôle of these different institutions may be obtained from the following statement by Doctor Cramer:

The organization of research work in agriculture in the Netherlands Indies has followed different lines. Out of a botanical garden with a small scientific staff developed a department of agriculture, industries and commerce, which, as a government institution endeavors to stimulate these branches of human activity and to improve their results.

Large plantation companies have established their own experiment stations which are absolutely independent of government control and support many of the other private stations, like those for rubber and coffee and have also local importance as they help local farmers besides doing research work, sometimes also, private interests combine and raise special funds for the solution of important problems that form a serious menace to their work. Such are the coffee borer funds.

The most significant point to remember about research work in the Netherlands Indies, as Cramer says, is that research work has "adapted itself all the time to the special needs of the moment and of the interest involved."

ORGANIZATION OF THE GENERAL EXPERIMENT STATION AT BUITENZORG

On this subject, I consulted the 1925 and 1926 annuals of the Department of Agriculture, Commerce, and Industry. Mr. Koch gave me later information on the Institute for Plant Diseases, which was not formerly under the General Experiment Station, but is now incorporated with it under the same head.

Through the direct or indirect introductions of my sponsor, I met and obtained valuable information from the following men: Mr. De Veer of the Division of Permanent Crops, Mr. Van der Meer of the Moeara Seed Garden, Mr. Groenewege of the Microbiological Division, Mr. Leefmans, Doctor Van der Goot, Doctor Schwarz, and Doctor Doyer of the Institute for Plant Diseases. My contacts also with the Librarian of the Department, with Doctor Bubberman, Head of the Veterinary Laboratories, and with Doctor Valeton, Director of the Middlebare Landbouw School, as well as with prospective *landbouwconsulenten* (similar to the higher class of the extension agents, in the Philippines), all contributed to the making of my stay in Java very instructive.

The different divisions composing this station are: Laboratory for soil research, chemical laboratory, botany laboratory, and an agricultural division. The last is subdivided into a section for annual crops and another for perennials. As stated above, recently the Institute for Plant Diseases was placed as a division under the General Experiment Station. The Institute is composed mainly of a botany laboratory, zoölogical laboratory, and the section for inspection service.

WORKING OF THE SECTIONS FOR ANNUAL AND PERENNIAL CROPS

My information on this subject is derived not only from the reprints of publications kindly furnished me by Mr. Koch and from his 1925 and 1926 Annual Reports, but from the more important sources of observations made in the fields at Tjikenmeuh and at Moeara, and from occasional explanations made by Mr. Koch. The main divisions of work of the annual crops section are the improvement of rice, maize, cassava, fiber roselle, and peanut; fertilization experiments with rice and other crops; tests and use of various species of cover plants and green manures; the improvement of inland agricultural implements; and the distribution of improved seeds and improved implements, such as the Moeara plow, Moeara hand cultivator, the *katjip*, the *landak*, and the *twin landak*. I brought with me when I returned to the Philippines a model of each of these implements.

The relation of seed raising in the Moeara Seed Garden to the farm work of the prospective *adjunct-landbouwconsulenten* (whose training farms are in Moeara also) and to the system of training of these future *adjunct-landbouwconsulenten* themselves struck me as a possible model for the Philippine Government.

The work in the Section for Perennial Crops on rubber and kapok budding and the grafting of coffee as a means of multiplication of important hybrids and mother plants impressed me greatly.

After studying the method used by Mr. Koch in keeping experimental records, I came to the conclusion that it is many times better than the card or loose leaf system I have been using in the Philippines, and so I have adopted it with a little modification.

I had the privilege of taking an active part in the work of actual inbreeding of corn and selection of desirable maize strains and in the selection of rice seedlings. I also saw the rice plants being inbred, with the inbreeding bags still on, before the panicles were harvested. I also observed the methods of seed bed preparation, seed sowing, uprooting of the seedlings, and transplanting, in the rice work. The cassava plants were not in flower and hence there was no self-pollination work with this plant at that time. However, I studied the published results of cassava breeding including a tabulated system of identifying the varieties now growing in this section. As many of the cassava varieties we have in the Philippines came from this Station, this method of classification of cassava varieties will be very use-

ful to us at our College. I observed the different variety cultures of cassava of the Division. One of these cultures is of cassava seedlings grown from seeds which came from supposedly homozygous mother plants of the Randoe variety. The seedlings were far from uniform and prove the heterozygosity of the mother plants. This instance is illustrative of the value and soundness of the method now being tried by Mr. Koch in the improvement of annual crops; namely, the forced inbreeding of mother plants even of a species like rice which is supposed to be highly self-pollinating, the culture of the inbred offspring under the most favorable soil and other conditions to get the greatest variability among the plants, the selection and tests of desirable inbred strains, and the obtaining of first, second, and third (single, double, triple) crosses with such a plant as the maize. As I understood from Mr. Koch it is his plan to compare in the future the following methods of rice improvement:

1. The use of pure lines.
2. The use of mixtures of inbred pure lines.
3. The use of mixtures of inbred lines after growing them under supervision, for two generations.
4. The use of second hybrid generation seeds of two inbred lines.
5. The use of mixtures as in No. 3, but grown two generations.

In the improvement of corn, two methods will ultimately be compared; namely, the ear-remnant method of selection and the use of triple hybrids of strains produced by several generations of self-pollination. As the plan now stands, the strains to be used in the production of triple hybrids will have been inbred five times.

As to the ear-remnant method, the use of it has been in progress for five or six generations. I was fortunate in catching a planting of corn to which the ear-remnant method of improvement was being applied. The selection of the best strains, which in the cultures were represented each by fifty-five hills was based on the following points:

1. Proper time for maturity
2. Number of plants suckering
3. Number of plants producing more than one ear at one node
4. Number of plants considered abnormal. Plants showing the following characters are considered abnormal:
 - a. Dwarfing
 - b. Bent stalk
 - c. Zigzagged stalk
 - d. Ears at the tassel of the main stalk
 - e. Colored plants outside the normal green
 - f. Barrenness
 - g. Ears with widely open tips
 - h. Plants lying down
 - i. Large husk blades
 - j. Diseased plants
 - k. Abnormal height of ear on the stalk
5. Yield

In the comparison of strains, point No. 1 is considered three times important, point No. 2, two times, point No. 3, one time, point No. 4, one time. An index of selection is obtained by finding the difference between three times point No. 1 on one side and two times point No. 2 plus one time point No. 3 plus one time point No. 4 on the other side. Strains showing a high index and at the same time giving a good yield are selected.

In regard to the obtaining of the inbred strains to be used in the production of triple hybrids, I obtained the information that the work was started with about 1,000 ears. From this number about 300 were selected with which to start the inbreeding. After four generations of inbreeding, there have been ultimately saved or have survived ten strains or numbers. To save some of these the plants had to be manured and taken exceptionally good care of otherwise. I was lucky in being able to see these strains in the field and to see the operations of inbreeding, which is now in the fifth generation. The ten numbers which have been saved will be used in the production of forty-five combinations or forty-five triple hybrids, the yields of which will be compared. The selection of strains each generation can not be based on the yield as the plants are treated and hence the yield is not normal. Determining the yield by the ear-remnant method is not practical as not enough seeds are obtained to allow the saving of the "remnant" material. But the selection is based on characters which are supposed to give a reliable index to yield. These characters are:

1. Earliness and uniformity of flowering
2. Uniformity of height of plants
3. Tendency not to produce suckers
4. Tendency not to produce more than one ear at one node
5. Tendency not to bend or lie down
6. Resistance to pests and diseases
7. Freedom from other abnormalities

The process of self-pollination is done at about noon, the cultures being visited every day for such plants as are ready to be treated.

In the work of corn breeding, an attempt is being made to determine the best method of self-pollination. The use of bags made of drill cloth for covering the female organ is being compared with the use of paraffined bags with protection from too much heat from the sun. Two kinds of protective material are being tested, the ordinary woven-bamboo and the asphalt paper, the kind used in Hawaii for mulching pineapple and sugar cane fields.

An important phase of the work in Mr. Koch's section is the selection of rice strains resistant to the bending effects of the weight of their fruits, of wind, and of other factors. A machine for determining the bending resistance of individual plants just as these stand in the field has been devised by Mr. Koch for use in this determination. In addition to the use of this physical method of determining bending strength, Mr. Koch's as-

sistant, Mr. Van de Meulen, is making an attempt to determine if strains may be selected for this character on the basis of the anatomical condition of the rice stem. Both the physical and anatomical methods are relatively new to me as far as rice is concerned, and deserve serious study.

In the Section for Perennial Crops the most important subjects I studied were the improvement of rubber, including the propagation by budding; the improvement of coffee, a good deal of which work is done in the Government Coffee Estate at Bangalan; and the improvement of the coconut plant, kapok, and oil palm. Following are some of the unelaborated notes I made while visiting the Bangalan Coffee Estate:

My informant in Bangalan was the Superintendent of the Estate, Mr. Doornberg, to whom I am deeply indebted. The main lines of work in Bangalan are:

1. Crossing of varieties. In the production of hybrids the method used is to plant the parent varieties side by side and allow insects to do the cross pollination. The variety *Congensis* is said to cross easily. Small bean flowers generally cross easier than large bean flowers, because the latter self-pollinate before opening.

2. Sowing the seeds in the nursery

3. Selection of hybrid seedlings in the nursery

4. Planting out the selected seedlings

5. Selection of superior trees. The points on which selection is based are yield, resistance to diseases and pests, size of bean, and length of bean stem. If the stem of the bean is short, the beans become crowded and some of them will be small. Therefore, short stem beans are avoided.

Usually three years and nine months waiting is necessary before selection is accomplished. To hasten work, selection is done when the seedlings are eight months old. The selected seedlings are grafted on old stocks, which are always available. At two years of age the grafted plants begin to produce, and so a saving of one year and nine months is effected.

6. Preparation of sixteen grafts from each selected tree, and planting these grafts in the Museum Garden.

In grafting, the stock used is about the thickness of a finger. If stumps are grafted, four sprouts are grafted at the same time, then ultimately thinned to one. The variety commonly used for stock is *Robusta* 129.01 which is supposed to be a hybrid between *Robusta* and *Quillou*. *Quillou* itself is a good stock.

In the Museum Garden the plants are distanced 10×10 feet if *Robusta* and *Kawisarie* hybrids; 12×12 feet if *Excelsa* and *Liberica*; and 8×9 feet or 8×8 feet or 9×9 feet if *Arabica* or *Congensis*. The depth of the hole is $1\frac{1}{2} \times 1\frac{1}{2}$ feet in Bangalan where the soil is deep. If underlaid by hard pan, the hole goes through this.

7. If a clon in the Museum Garden is selected, 49 grafts are made and planted in another garden. If this clon is exceptionally promising, in

addition to the 49 grafts, a hectare of grafts and another of seedlings are planted to it in the hectare gardens. In getting seeds from the Museum Garden, only trees in the middle of the culture are used to insure a high state of purity.

8. The hectare gardens are kept under observation for from two to three years, after which time, one is able to tell the true value of a clon. If found desirable, it is used for the production of seed for distribution outside. At the time of my visit I was informed that there were already clons occupying three to four hectares each.

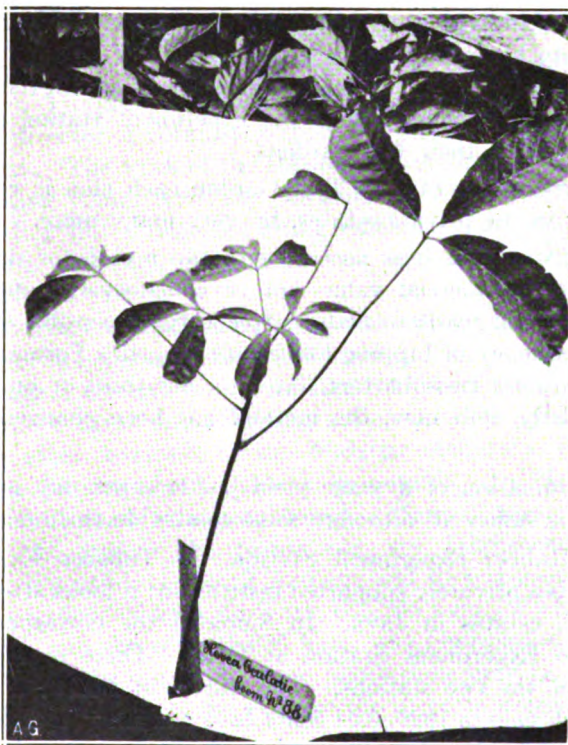


Fig. 3.—An introduced budded plant from mother tree No. 88, supposedly the best *Hevea* mother tree known in Java.

The value of a clon is finally known after nine years; in less time if it is extraordinarily promising.

The other phases of Bangelan work of interest to coffee planters are the use of cover crops and shade trees, pruning of coffee trees, and the control of coffee borers. An excellent system of recording observations and performance records of trees is used.

SOME OF THE PRIVATE STATIONS

The private stations I visited are the Central Rubber Experiment Station at Buitenzorg, the Tobacco Experiment Station at Klaten, the Sugar Cane Station at Pasoeroean, the Cinchona Experiment Station at Tjinjiroean, Pengalengan, the Coffee and Rubber Experiment Station in Malang, and the Tea Experiment Station at Buitenzorg.

In the Rubber Experiment Station my informant was Doctor Bobiloff who is in charge of the rubber breeding work. I learned from him the method in use at the station in the improvement of rubber. This method includes the keeping of performance record of yield and the number of latex vessels of individual trees, the selection of the superior ones and the propagation into clons of these selected trees. As a result of this work there are now being tested in Sumatra eleven clons and in the Test Garden at Buitenzorg, thirty clons. Both the experiment station and the commercial estates have their test gardens.

In the Experiment Station Test Garden each clon is represented by 20 to 23 trees; in the private estates, by very many more.

It is estimated that it is necessary to tap a clon for seven years, at least, before its commercial value can be conclusively determined. Because heavy tapping tends to make a tree very susceptible to brown bast disease, the frequency of tapping has been changed. Formerly a tree was tapped daily around two-quarters; later on one-third or one-half circumference, half daily, and now, the method has been changed to alternate days.

The determination of average yield per tree per day is done once a month. This is sufficient, although some estates do this once a week.

Like the Rubber Experiment Station, the Tobacco Experiment Station at Klaten is a privately supported institution; it looks after the interest of the tobacco estates in Java. In Sumatra the corresponding station is the Tobacco Experiment Station at Delhi. There is no organic connection between the two stations. The station at Klaten is supported by 19 estates which paid in 1926, 0.64 cents Java currency (equivalent to about 50 centavos Philippine currency), per pound of tobacco produced by them. In the year 1927, it is expected that the estates supporting the station will grow about 9090 bouws (1 bouw=0.71 hectare) of tobacco and will have to contribute 110,750 guilders for the support of the station. The breeding garden of the station occupies 10 bouws, five of which are used every year. Some of the tobacco farms under the estates are irrigated and some are not. In irrigated places rice is grown in rotation.

The important lines of work of the station are: The separation and germination test of seeds for different member estates. In seed separation a winnowing machine is used consisting mainly of a motor which runs a fan. The rate of revolution of the motor and the amount of velocity of wind

from the fan may be controlled, and hence different grades of seeds may be separated. The test of seed germination is performed in the laboratory.

The main work in the improvement of tobacco consists in crossing different varieties, the most important of which are EK, Canary, and Doorschieter. There are two strains of Canary, the normal and the dwarf.

The study of tobacco pests and diseases is a very important phase of the Klaten work. A book embodying the results of this study and covering a long period of time was published in 1921.²

I am indebted to Mr. Beet, Acting Director of the Station for information on the Station work and for taking me around the stations during my visit in Klaten.

The Government Cinchona Experiment Station. This station was established on May 31, 1911, and located at the government cinchona plantations in Tjinjirean, Pengalengan, near Bandoeng. The personnel consists of a director, a botanist, a chief analyst, an analyst and an agricultural assistant. The work of the station consists in:

1. Making commercial and agricultural analyses of cinchona bark
2. Sending out advice regarding cinchona culture
3. Doing chemical, botanical, and agricultural research work to improve cinchona culture

The Government cinchona plantations are found in Tjinjirean, Tjibeureum, Rioeng-goenoeng, Kawali-Tjiwidei, Nagrak, Rantja-Blang, Tjibitoeng, Telaga Patengan and Lembang. All were established about 1860 by Junghuhn. Nagrak and Lembang are on the slopes of the Tanghoeban-Prachoe, the other seven are on the Malabar mountain, Pengalengan plateau, and the Kendeng and Pasoeak mountains. In 1877, another plantation, named Tirtasari, was established. Many of these plantations were abandoned. At present the plantations are Tjinjirean and Tirtasari, Tjibejureum, Poentjak Gedeh, Tjibitoeng and Rioeng-goenoeng. In 1925, the harvest was 669,300 kgm. dry bark, 655,265 kgm. of which was "fabric" (factory) bark and the rest, 13,035 kgm. was pharmaceutical bark.

Some idea of the rainfall in these plantations may be gained from the following figures which are the average for 10 years preceding 1925:

	<i>mm</i>
Tjibeureum.....	1176
Tjibitoeng.....	1136
Tjinjirean.....	2775
Rioeng-goenoeng.....	3320

In the nurseries, there were, at end of 1925, 1,314,000 plants as follows:

- 433,000 *Ledgeriana* seedlings
- 433,000 *Succirubra* seedlings
- 448,000 *Ledger* buds on *succirubras*

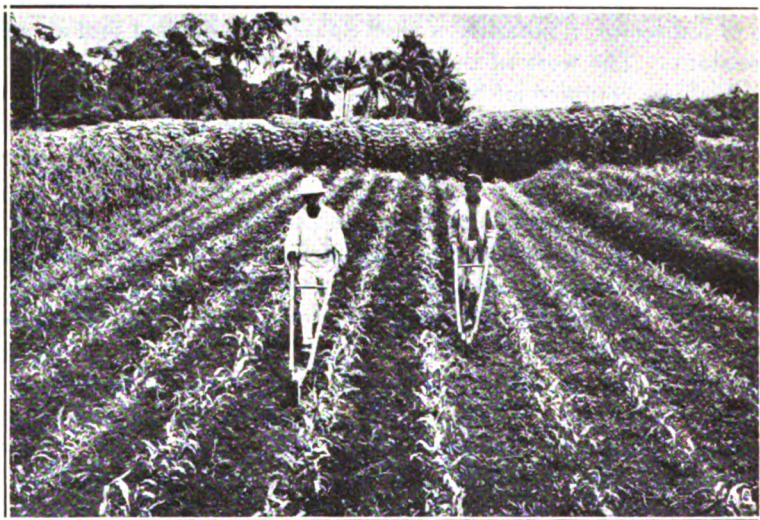
² Jensen, Hj. 1921. *Ziekten van de Tabak in de Vorstenlanden.* Mededeeling No. XL, Proefstation voor Vorstenlandsche Tabak.

The total area at end of 1925 was 877,937 hectares, as follows:

	ha.
Ledgeriana.....	832,560
Hybrids.....	12,364
Succirubra.....	33,013

Private cinchona plantations. The oldest of these plantations were started in 1864. At present there are 108, giving a harvest of 20,000 to 61,000 kgm. bark. The total for 1925 was 559,895 kgm.

The so-called Government Experiment Station of Cinchona has ceased to be such, although the station (at Tjinjirean) is still located in the Government Estate. The station is now privately supported by different plantations and the government plantations are on the same footing as the private.



(Courtesy of Dr. Valetan, Jr.)

Fig. 4.—At the left is shown one of the graduates of the Middle Agricultural School using the "Moeara" cultivator in the seed farm.

The Sugar Experiment Station at Pasoeroean. This station is said to be the largest of its kind in the world. It is supported entirely by private companies and concentrates on only the one crop, sugar cane. "It has not only control divisions for studying the agricultural problems of cane production, for the improvement of the chemical and mechanical processes involved in the industry, but also a set of agents scattered over the principal cane growing districts, linking up the local planter with the central stations."

The Station spends yearly for breeding and other activities about one million guilders (about 900,000 pesos). While the office and much of the

work of the cane breeder are in Pasoeroean, the greater part of the hybridization work is done at Blambangan. The man in charge of the breeding operations is Doctor Posthumus. Doctor Jeswiet and Doctor Bannier are no longer in Java.

At present the Experiment Station at Pasoeroean believes that 2878 POJ is the best variety it has produced; it is expected, after a few years, to supplant the other varieties which have been popular, such as DI52 and EK28. It is believed that it would be quite difficult to produce a variety better than 2878 POJ. This variety needs no mountain garden for the production of desirable and healthy points. However, the breeding work in Pasoeroean and in its breeding garden at Blambangan is being prosecuted with undiminished energy. 2878 POJ was 1 seed in 1921, 1 plant in 1922, occupied 0.01 bouw in 1923, 50 bouws in 1924, 1752 bouws in 1925, and 30,591 bouws in 1926.

There are two things which should be of interest to cane planters in the Philippines in connection with the production of seedling varieties in Java. These are the payment of a royalty to producers of good seedling varieties and the Jeswiet method of identifying varieties. The rules governing the payment of the royalty are published in the Yearbook of the Sugar Syndicate. The offer of this royalty is intended to stimulate the breeding of improved varieties. Whether or not a variety is new is decided officially by the Experiment Station and in this decision, the method devised by Doctor Jeswiet for identifying varieties plays a very important rôle. The Jeswiet method is rather elaborate, and based on the observation of about thirty-two hair groups on the bud and twenty-one on the leaf. That this method is found to be effective in clarifying nomenclatic confusion is shown by the record at Pasoeroean. It has been found, for example, that ten or more variety names used in Java or elsewhere may really refer to one single variety. By applying the method, names have been reduced to two-fifths the original number. In the future it is probable that cytological examination will play a more important rôle than it does now in determining the identity of a sugar cane and in tracing its genetic origin. Doctor Bremer in Pasoeroean who kindly explained to me his work on the chromosome of *Saccharum* species has been working along this line for a number of years and has obtained wonderful results.

One thing which impressed me much in Pasoeroean is that the greater part of the breeding work is not done there but in Blambangan which is about three hundred meters higher in elevation than Pasoeroean. The reason for having the breeding garden in Blambangan is that many parent varieties do not flower in Pasoeroean at the same time as those with which they should be crossed. In Blambangan they flower at the same time and hence crossing is possible. For a full account of the cane breeding work in Java for the period 1893-1925 reference may be made to Doctor Bannier's paper published in the *Archief voor de Suikerindustrie in Nederlandsch-Indie*, No. 19, 1926.

Along entomological lines, I was given the privilege of a conference with an entomologist of the station, Dr. E. H. Hazelhoff, who explained to me in brief the work of the station in the importation of natural enemies of the sugar cane borers and white louse and the propagation of these enemies, both imported and native, on the estates as a means of lowering the cost of controlling cane pests. I was informed that an estate spends in general six to ten thousand guilders a year in combating the white louse by means of soap emulsion and tobacco extract. One of the louse parasites being propagated is *Encarsia flavoscutellum* Zehntner.



(Courtesy of Dr. Valetton, Jr.)

Fig. 5.—A class in the Middle Agricultural School learning how to tap Hevea rubber trees.

Coffee and Rubber Experiment Station at Malang. At this station I met Doctor Ultee, the director; Mr. Rishambers, in charge of coffee; and Mr. W. Bally, in charge of rubber investigations. This station has a seed garden at Soemberasin which I did not have an opportunity to see. The station looks after the interests of estate coffee plantations, not of the plantations of the natives. Station support is obtained from a tax of one guilder per hectare of estate members and about 20 cents per picul of coffee produced. This last tax varies each year.

Vegetative propagation is a very important phase of the work. The variety used as stock is usually Excelsa.

In selection, the following characteristics are preferred: large size of bean, big production, resistance to coffee rust, good development and strong trees.

Cover crops used: The cover crops used in the Java coffee plantations are usually *Indigofera hendecaphylla*, used especially to protect sloping lands from erosion, *Crotalaria anagyroides*, *Carotalaria usaramoensis*, *Vigna oligosperma*, and *Centrosema pubescens*. For shade trees: *Lucaena glauca*, *Albizia stipullata*, *A. Moluccana*, *A. sinensis* and a few others. Formerly, Hevea trees were also used but at present it is not a common practice to use this species as it is considered dangerous to plant coffee and rubber together.

As to rubber work, I was informed that one of the selected clons now yields per tree 40 grams a day at 9 years of age. This yield represents the average of 100 trees. Very few clons come out good.

The Tea Experiment Station: I met the director of the station, Dr. Ch. J. Bernard and also Doctor Stewart, the tea expert and breeder who took great pains in explaining to me the work he was doing in tea improvement. Mr. Keuchenius who is in charge of the vegetative propagation garden and the cover crop and shade plant cultures of the station took me to see these cultures and explained in detail the objects of his many experiments.

The important lines of work of the station are:

1. Selection of best yielding strains of tea
2. Propagation both by seed and by grafting of the selected plants
3. Test of different species of plants for cover crop and shading purposes *

Doctor Stewart was kind enough to take me to the selection gardens and to the garden containing grafts of the selected plants. These gardens are in the Pondok Gedeh Estate, and are located many kilometers from Buitenzorg. I was informed that the station has cultures in five other estates in Java. A visit to a tea factory supplemented my tea studies.

FRUIT STATION IN PASOEROEAN

This station was in the care of Mr. E. de Vries, horticulturist. The important cultures are mango, banana, pumelo, and cover crops. The best varieties of mango, Aroemanis, Goleh and Madoe are represented in the station's collections. There is a variety which is probably a natural cross between Aroemanis and Goleh and bears a name which means *ne plus ultra*.

One important work is mango budding. Ninety-four per cent success has been reported. No wax is used with the binding tape but the plants are partly shaded. In the culture of fruit plants use is made of cover crops such as *Mimosa invisa* and *Calopogonium muconoides*.

An interesting banana that I found is called Pisang Sewoe (*Musa chilliocarpa*). The bunch is several meters long, reaches the ground, some-

times necessitating the digging of a hole in the ground to accommodate the elongation. The first three or four hands of flowers are male and the rest, female.

PLANT INTRODUCTION

As a result of my fellowship stay abroad, I was able to introduce into our College planting materials of about one hundred species of plants, the most important of which are seeds of selected plants of rice, peanut, roselle and *Hibiscus cannabinus*, budded plants and buds of the best clons of Hevea rubber in Java, two budded plants of the coffee hybrid (Kawisari B) in Java, seeds of the two best species from selected plants of *Cinchona* (quinine), the sweetest varieties of Java pineapple, two species of *Artocarpus*, new or not common in the Philippines, four living plants of the Surinam kapok, found to be excellent stock for budding the ordinary kapok, the best variety of *Lansium domesticum* known, the Duku, two varieties of banana related to the banana of commerce for use in our banana breeding work in this College, seeds of the best species of cover and green manure crops of Java and many others.

I brought also a model of each of the improved agricultural implements produced by Mr. Koch of the General Experiment Station. These implements are the Moeara plow, Moeara cultivator, *katjip*, *landak* and *landak kembar*. The last three are for weeding lowland rice fields. The *Moeara wiedoestel* is a cultivator for dry land. All of these implements promise to be valuable in our agricultural promotion work in the Philippines.

A complete list of the plants introduced follows: *Achintenes* sp.; *Achras sapota* L.; *Amaranthus* sp.; *Ananas comosus* Merr.; *Arachis hypogaea* L.; *Aristolochia* sp.; *Artocarpus integra* Merr.; *Artocarpus rigida* Bl.; *Artocarpus champeden* Srpeng.; *Asparagus* sp.; *Aster* sp.; *Baccaurea racemosa* Muell-Arg.; *Cassia Fistula* L.; *Caladium bicolor* Vent.; *Cassia grandis*; *Cassia multifuga*; *Cassia nodosa* Ham.; *Calopogonium muconoides* Desv.; *Carica papaya*; *Ceiba pentandra* Gaertn. Var. *Caribaea*; *Celosia Cristata* L.; *Coleus tuberosus* Benth.; *Cosmos* sp.; *Coreopsis* sp.; *Cinchona Ledgeriana* Moens.; *Cinchona succirubra* Par.; *Crotalaria Juncea* L.; *Coffea arabica* x *C. liberica* (Kawisarie B.); *Cyrtostachys lakka* Becc.; *Cyrtostachys rendah* Bl.; *Cleome* sp.; *Clematis hirsuta*; *Dialium indum*; *Diospyros kaki* L.; *Flacourtia inermis* Roxb.; *Gerbera jamesonii* Bol.; *Gladiolus* sp.; *Glycine max* Merr.; *Helianthus* sp.; *Hevea brazillensis* Muell.-Arg.; *Hibiscus Sabdariffa* L.; *Hibiscus cannabinus* L.; *Hydrangea hortense*; *Hippeastrum* sp.; *Impatiens sultani* Hook.; *Indigofera hendecaphylla* Jacq.; *Impomoea batatas* Poir.; *Impomoea* sp.; *Jacaranda ovalifolia* R. Br.; *Jacobinia vellutina*; *Lansium domesticum* Jack.; *Latania commersonii* Grnel.; *Licuala grandis*; *Licuala amplifrons* Mig.; *Manihot utilissima* Pohl.; *Manilkara kauki* Dubard; *Mirabilis jalapa* L.; *Musa sapientum* L. Houth.; *Myristica fragrans*; *Nephelium lappaceum* L.; *Nephelium mutabile* Bl.; *Oryza sativa* L.; *Phajus tankervilleae* Bl.; *Pelto-*

phorum ferrugineum Benth.; *Poinciana regia* Bj.; *Parkia speciosa* Hassk.; *Phaseolus radiatus*.; *Phlox drummondi* Hook.; *Plumiera acutifolia* Poir.; *Salvia* sp.; *Solanum* sp.; *Spathoglottis plicata* Bl.; *Spathodea* sp.; *Tagetes* sp.; *Tephrosia candida* DC.; *Tephrosia noctiflora* Bojer.; *Tephrosia vogelii* Hook.; *Theobroma cacao* L.; *Thrinax argentea* Lodd.; *Torenia* sp.; *Vigna Hosei* Backer. (*V. Oligosperma*); *Voandzeia subterranea* Thouars; *Zea mays* L.; and *Zinnia elegans* L.

The plant materials in the preceding list were introduced in three ways:

(1) By mail. Every month during the period between January 9, 1926, and July 18, 1927, I sent to my assistants in this College several shipments of seeds and other propagating materials. When I returned August 23, 1927, I found most of the plants from these seeds growing.

(2) When I returned, I brought with me three Wardian cases and one box full of plants. One of the Wardian cases contained plants I bought and collected from private sources, one contained plants given to me by the Botanical Garden at Buitenzorg, and the third contained four budded stumps of *Hevea*, four seedlings of Surinam kapok and two budded plants of the coffee hybrid *Kawisarie B*, all from the Economic Garden of the General Experiment Station. The open box contained an assortment of plants from the Botanical Garden at Kuala Lumpur. With my experience in bringing these cases to the College I can now understand why it is not always easy to introduce plants in Wardian cases without some one to take care of them on the way. In the first place one species may be adapted to the case while another is not. Had I not been with my cases, probably fifty per cent of my plants would have perished en route.

(3) Besides the plants in the cases and box, I brought with me many samples of seeds, mainly from the section of Annual Crops of the General Experiment Station, from the Botanical Garden at Kuala Lumpur, and from the Experiment Station at Serdang, Federated Malay States.

THE SEASONAL DISTRIBUTION OF EGG PRODUCTION: THE NORMAL EGG PRODUCTION CURVE¹

F. M. FRONDA

Of the Department of Animal Husbandry

WITH TWO CHARTS

It is accepted that the tropical countries are the original homes of the progenitors of the present day breeds of domestic fowls. As human civilization has progressed so has the domestication of poultry. Peoples have moved from place to place, and often to regions where the conditions are very different from those found in the tropics. In these migrations the domestic hen has been taken along as an essential part of the household. By instinct, the hen adapted herself to her new abodes so that her kind could be perpetuated. This power of fowls to respond readily to the environment is an attribute which only domestic animals possess.

In temperate countries, like the United States and Canada, the number of the hen's working hours is considerably less during the winter months than during the other months of the year. Because the egg production is lowest during these cold, short winter days, it is usual to attribute this phenomenon in the distribution of egg production to the marked changes in weather and other environmental conditions. In tropical countries, the difference in the length of day and night during the different seasons of the year is practically nil. Similarly, the variations in the temperature during the year are small. Basing judgment on the reasoning advanced in the usual explanation of the peculiar seasonal distribution of egg production in the temperate countries, should a definite and fairly uniform distribution of eggs be expected in tropical countries such as the Philippine Islands, Java, Borneo, Siam, Sumatra, and India?

Information obtained from various reliable sources from different parts of the Philippine Islands leads to the conclusion that egg production varies with the different seasons, there being more eggs produced during the first half than during the latter half of the year. Observations in the local market of Los Baños and in the markets of the neighboring towns seem, in a general way, to bear this out, as there is a scarcity of hens' eggs in the markets from August and a decided scarcity during the months of November and December. Such a scarcity is not experienced during the first six or seven months of the year. It appears, therefore, that there is a certain definite variation in the number of eggs produced in the different parts of

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the year. To determine how much this variation is and thereby establish a distribution curve as may be expected under natural conditions was the object of this study. It is hoped that the data here reported will furnish an answer to the frequent question as to the number of eggs that one may expect from a flock of hens during any given month of the year.

The study was conducted with the use of the poultry flocks of the College of Agriculture. It was started in 1922, and a number of preliminary reports have been made. The first of these progress reports (Catambay, 1924) presented the data obtained during the first year of this study, 1922-1923, for Cantonese, Native, Rhode Island Red, Barred Plymouth Rock and White Leghorn breeds of chickens. The second report (Fronza, 1924) gave the data for only the Cantonese breed, and the third report (Fronza, 1927) presented the data obtained during the first four years of the study for only the Cantonese and Native breeds of chickens. The fifth year of the study is now completed and a full report can now be made with perhaps sufficient grounds for more definite conclusions.

The egg records of the flocks of the College from September, 1922 to August, 1927 were compiled and used in this study. The chickens were classified according to breed, and separate tables were prepared for each breed. All of the breeds used in this study were kept in separate pens, and received practically the same treatment. None of the birds were allowed to set, and broodiness was broken by confining the broody hen for three or four days in a compartment provided with a concrete floor. Some minor changes were made in the course of the study, but whatever their nature they were made common in all of the pens under consideration. The chickens received what is considered under local conditions as perfectly normal egg laying rations throughout the five years this study was carried on. All the breeds had from fifteen to eighteen birds in each pen, with the exception of the Cantonese breed, in which there were at least twenty individuals in the pen during the first three years of this study, and about forty each year during the last two. The Rhode Island Red breed was not included in the study during the last year, as the number fell below ten, and during the last part of the year only a few hens were left.

For comparison, data obtained both from the United States and Australia were used. These data are only for one year; they are, however, considered as representative of conditions actually existing in those countries. For the purposes intended in the present report, these one year records are considered sufficient.

RESULTS AND DISCUSSION

The results obtained in this study are given in tables 1 to 5. The average percentages of egg production are graphically presented in chart 1. The average figures given in the tables were reduced to the "number of egg" basis and the results are given in table 6. This was done in order that

the figures may be readily applied by those who may care to use them as guides in poultry raising operations. A comparison of the data for the Cantonese with those obtained in the United States and Australia are given in table 7 and presented graphically in chart 2. It may be mentioned in passing that the Cantonese fowls were chosen and compared with the most common dual purpose breeds in those two countries for the reason that the Cantonese is the most common breed in this locality.

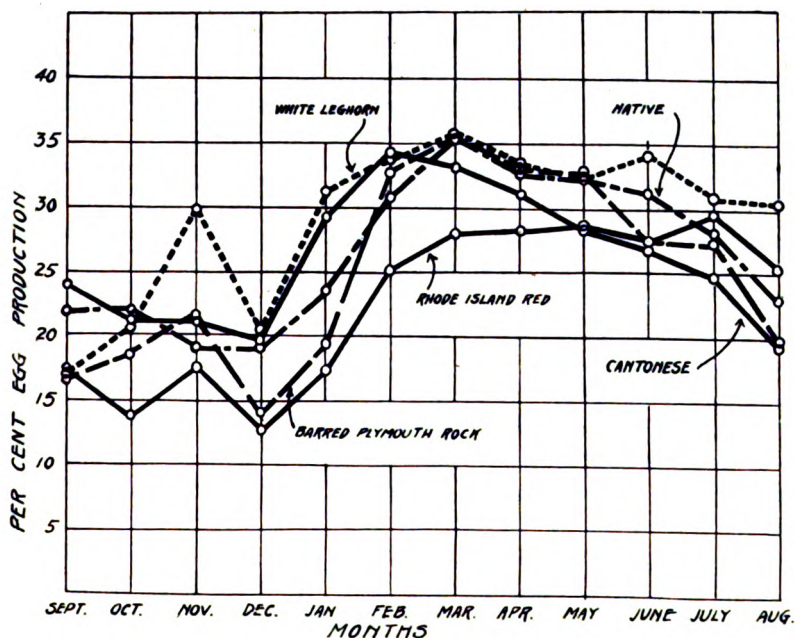


Chart 1.—Showing the distribution of egg production of Cantonese, Native, White Leghorn, Barred Plymouth Rock and Rhode Island Red breeds. Average for five years, 1922 to 1927.

It may also be seen in the tables that the "laying year" does not coincide with the calendar year, that the laying year begins with September and ends with August, instead of beginning with January and ending with December. The reason for this is that most of the hatching of eggs done in this College is made from December to March, inclusive, as these months have been found to be the best for this purpose (Resananda, 1925); and a majority of pullets hatched during these months will begin laying in September, though some of them may start as early or even earlier than the middle of August. Thus, in order that a full year's egg record of a pullet may be obtained, the record must be started right at the beginning of the laying period. For this reason, September 1 of every year has been arbitrarily chosen as the beginning of the laying year.

The "percentage egg production" is obtained by dividing the actual number of eggs laid by the flock in one month by the "total possible number of eggs" for that month, and multiplying the quotient by 100. The total possible number of eggs from a flock is obtained by multiplying the number of hens in the flock by the number of days of the month during which time they were in the pen. Thus, if a flock of 100 hens laid 25 eggs in one day, this means that 25 out of 100 hens laid during the day, thus the egg production of the flock is expressed as 25 per cent. Similarly, if a flock of 20 hens had a 25 per cent production in September, this means that 150 eggs were produced by that flock during the month.

From these data, it may be seen that there is a very significant period in which egg production is really below the average and that practically this period falls during the same period of the year in all of the breeds studied. It may be safely concluded, therefore, that there is a definite type of egg production curve in this country. Starting at almost the same level in the month of September the curve slowly declines until the minimum production is reached some time in either November or December. Then by the month of January it begins to rise, this higher level being maintained until about May or June whence egg production begins gradually to decline again. By comparing the figures in tables 1 to 5, such a tendency is shown by all of the breeds represented in this study. The figures given in table 6 show this peculiar distribution very markedly. It is of interest to note in this connection that similar results as regards egg production have been observed among Native hens by Mariano (1919) and by Fronda (1919) working independently in different years.

Attention may be called also to the slight deviation from this general tendency in the figures in tables 3, 4, and 5. In these tables, it may be seen that instead of following the general tendency to gradually drop at the start, the curves slightly rise to a point reached in November then the general drop is followed. This is due to the fact that these pens are made up of about a half and half mixture of hens and pullets. The pullets are just beginning their laying year. They lay for a short period after they reach the period of maturity, and thus the tendency is for a slight increase in egg production of the pen during these early periods of the laying year. The Cantonese and Native breeds on the other hand were always composed of hens, and therefore more homogeneous than either of the pens representing tables 3, 4, and 5. Thus, their egg production curves are very uniform from the beginning to the end of the year. The curves of the White Leghorn, Barred Plymouth Rock, and Rhode Island Red followed the general drop in December and from then on, the egg production curves of all breeds represented in this study are essentially the same.

That this kind of egg production curve is very similar to those of the United States and Australia, although they do not exactly coincide as to the time of the year is shown by the data given in table 7, and presented graph-

ically in chart 2. The time of the year at which the low and the high production occur in these different places is perhaps explainable by the differences in the weather conditions and other environmental factors. It is very apparent that there is a definite period of productivity and a definite period of rest, and that these periods occur at definite parts of the year depending upon the surrounding conditions in the locality. A more detailed discussion of the influences of seasonal changes on egg production curves will be taken up in a later paper. Let it be sufficient to state for the present that the periods of reproductive activity and of rest in the United States are in exactly opposite parts of the year from those periods in Australia for the reason that when the weather is nice and warm in the United States, and therefore favorable for egg production, it is cold and dreary in Australia and *vice versa*. Thus when the egg production curve rises in the United States, the tendency is to drop in Australia and when the chickens are most actively laying in Australia, the chickens are going through their period of rest in the United States. Because both the United States and the Philippines are in the Northern Hemisphere, the different seasons of the year occur during practically the same parts of the year, and hence the egg production curves of the chickens in these two countries follow the same trend. That is, when egg production increases in the United States, the tendency is also towards an increase in this country. The variation of egg production is not so marked in this country as it is in the United States probably because the weather conditions in the Islands are much more uniform than in the United States. The relationships of the egg production curves in this country and those of the United States and Australia are very plainly shown in chart 2.

The most striking egg production curves among poultry in United States has usually been attributed to climatic influences (Pearl and Surface, 1909). A considerable amount of work has been done and is still being done to overcome these forces of nature which offer a great obstacle to successful poultry farming in the temperate countries. The use of artificial light to increase the number of the hen's working hours during the winter months thus increasing the winter egg production has revolutionized the poultry industry in the United States and Canada. In its use, profitable results in increased egg production are obtained within a certain limit; the poultry farmer realizes an increase in his income resulting from an increased egg production during a period when ordinarily and normally there is low production.

When it begins to warm up in the spring, the hens lay better, and for this reason, it has always been assumed that the warmth of the spring causes this increased egg production during the spring months. But it has been pointed out by Pearl (1909) that "there is strong evidence to show that the shape of the egg production curve is based upon deep seated biological factors rather than directly on these climatic changes." That the small

climatic variations in the Philippines may have some influence on the egg production curve has been pointed out by Catambay (1924), but it is very plain that this egg production curve is built upon the same plan as those found in the temperate countries. As the progenitor of the present day domestic breeds of fowls is the Red Jungle Fowl common in the forests of this and other neighboring tropical countries, there is no reason for entertaining any doubt as to the similarity of the general plan of the egg production curves of fowls here and in other countries. The variations that are noted at present are merely modifications which are brought about by the peculiarities in the environmental conditions in their respective countries. How much influence these environmental factors exert upon the characteristic egg production curve of fowls in this country is a matter to be taken up in a later paper.

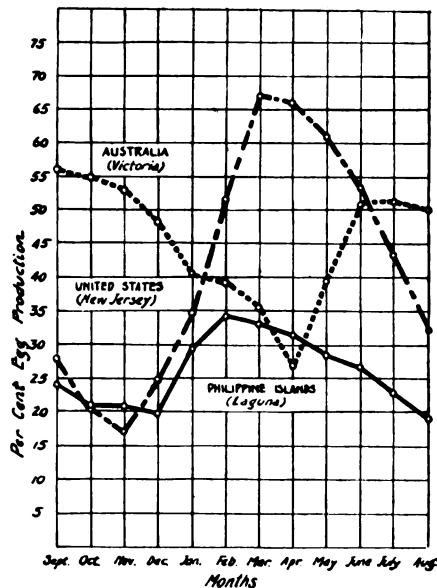


Chart 2.—Showing the curves of egg production in Australia (Victoria), in the United States (New Jersey), and in the Philippine Islands (Laguna).

There is sufficient reason to believe, therefore, that the curves of egg production reported in the present paper more closely follow the normal curve of the primitive races of poultry than those observed in temperate countries. Under the wild state, the chickens, by instinct, realize that they have to reproduce in order to perpetuate their kind, and that they have to do this when the weather conditions and the supply of food are most favorable; that is, during the period when the rearing of their most delicate young

is highly favored. After rearing their young, the adult individuals need some rest, and while their reproductive function is resting, they change their coat of feathers which had become old, ragged and dirty, preparatory for the next breeding season. Thus it is very plain that prior to the breeding season, chickens renew their vigor in much the same way that mammals exhibit unusual vigor and health just before the approach of the sexual season, as shown by the fighting and excitement common among wild animals during this period. By the end of this season, with these animals, fighting and excitement cease, the males become friendly, and in the case of stags, the antlers are shed shortly afterwards (Marshall, 1922).

Under the influence of domestication, such a course of affairs may not be found true to the very letter, because the domesticated birds are made to produce enough eggs to perpetuate their kind, in addition to the number necessary to pay for their keep and for the use of their keepers. For this reason, instead of completely resting during their period of rest, our domestic birds manage to produce during the regular breeding season. Thus it was observed by Pearl (1911) that in Maine "the laying year may be divided into four natural periods or cycles with reference to egg production." The first of these, the winter period which is roughly from November 1 to March 1, he claimed is essentially a non-essential process as the chickens are forced or stimulated in producing eggs during this period. The spring period, March 1 to June 1, which is the second of these periods, he claimed is the natural laying period of the domestic fowl in its reproductive cycle. From June 1 to September 1 forms the third period, and the fourth falls from September 1 to October 31. These last two periods are not sharply separated from one another.

Under local conditions it appears that there is but one reproductive and one rest period during the year. These correspond roughly to the two distinct dry and wet seasons of the year. The annual molt which forms the characteristic feature of the end of Pearl's fourth period marks the beginning of the breeding season, and the end of the period of rest. This molt has been observed in the Philippines to take place about July and continue to the early part of December, and this coincides in general with the gradual drop of egg production which begins about July or a little bit earlier. By January, all of the birds have completed their molt so that egg production increases until the peak is reached about the months of February, March, and April. This is maintained throughout the dry months of the first half of the year. If the fowls have had a chance to start in their reproductive processes earlier in the season, under natural conditions, a second or even a third clutch of eggs may be laid during this favorable period of the year. The earlier part of the latter half of the year is marked by rains and not infrequently storms, during the latter part of this period, the days are mild, but still there may be considerable rain at times.

The number of eggs laid by the birds during each of these periods,—the reproductive and the rest periods, is a different question altogether. This is dependent upon the age and individuality of the birds, the amount of care given them in feeding, housing, and management, and other things. A discussion of these factors is outside the scope of the present paper.

SUMMARY AND CONCLUSIONS

1. The monthly percentages of egg production of Cantonese, Native, White Leghorn, and Barred Plymouth Rock breeds of chickens for five years, 1922 to 1927, and of Rhode Island Red for four years, 1922 to 1926, are presented in this paper.

2. A comparison of the egg production curve of the Cantonese breed is made with that of the Black Orpington in Australia and of the Barred Plymouth Rock in the United States.

3. The data presented show conclusively that there is a definite type of egg production curve in this country.

4. The egg production curve in this country is very similar to those of the United States and Australia, although they do not exactly coincide as to the time of the year.

5. There is sufficient reason to believe that the egg production curve of chickens in this country is perhaps more nearly like the normal egg production curve of the primitive kinds of fowls than curves of egg production observed in the temperate countries.

6. The laying year may be roughly divided into two periods, the reproductive period, January to June, and the rest period, July to December.

7. The reproductive life of a chicken is a succession of the reproductive period and of the rest period, which correspond very closely to the two distinct dry and wet seasons of the year.

8. The annual molt coincides in general with the gradual drop of egg production which begins about July and ends about December.

9. If fowls start in their reproductive processes early in the season, a second or even a third clutch of eggs may be laid during the favorable period of the year.

10. The number of eggs laid by the hens during each of these periods depends upon the age and individuality of the birds, the amount of care given them in feeding, housing, and management, and upon other conditions of the environment.

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TABLE 1

Showing the monthly percentage of egg production of Cantonese chickens from 1922 to 1927

MONTHS	YEARS					AVERAGE
	1922-23	1923-24	1924-25	1925-26	1926-27	
September.....	26.6	23.8	24.7	24.4	20.6	24.02
October.....	19.5	24.3	27.3	16.9	18.0	21.24
November.....	12.6	25.0	28.5	26.0	14.1	21.24
December.....	5.6	25.4	25.4	19.0	22.4	19.56
January.....	33.2	22.7	36.4	28.9	25.2	29.28
February.....	35.7	36.5	36.7	31.9	30.0	34.16
March.....	31.5	32.8	35.9	34.3	30.6	33.02
April.....	36.2	30.5	32.4	29.4	28.1	31.32
May.....	28.0	31.2	26.7	26.4	30.1	28.48
June.....	28.1	28.7	25.1	27.6	25.1	26.92
July.....	28.8	22.2	27.3	25.5	20.0	24.76
August.....	26.7	12.7	26.7	17.1	12.9	19.22

TABLE 2

Showing the monthly percentage egg production of Native chickens from 1922 to 1927

MONTHS	YEARS					AVERAGE
	1922-23	1923-24	1924-25	1925-26	1926-27	
September.....	28.0	22.2	21.2	21.2	16.5	21.82
October.....	17.7	20.9	21.7	26.5	23.4	22.04
November.....	20.8	15.5	22.8	19.4	16.7	19.04
December.....	10.8	11.7	28.6	26.9	17.6	19.12
January.....	21.1	15.1	31.3	29.3	20.3	23.42
February.....	29.4	33.2	29.6	31.5	29.9	30.72
March.....	18.8	31.2	36.6	54.4	35.5	35.30
April.....	20.7	32.3	42.0	35.4	32.5	32.58
May.....	25.3	26.4	35.0	38.2	36.4	32.26
June.....	27.1	30.3	31.1	32.8	36.3	31.52
July.....	28.8	20.5	29.7	30.5	31.3	28.16
August.....	27.7	17.7	26.5	18.5	23.4	22.76

TABLE 3

Showing the monthly percentage egg production of White Leghorn chickens from 1922 to 1927

MONTHS	YEARS					AVERAGE
	1922-23	1923-24	1924-25	1925-26	1926-27	
September.....	19.8	18.6	5.8	28.4	7.1	15.94
October.....	15.2	17.7	14.8	18.8	36.7	20.64
November.....	29.5	16.8	40.7	18.1	43.7	29.76
December.....	5.5	16.2	38.4	21.4	20.6	20.42
January.....	24.2	26.1	37.5	37.3	30.8	31.18
February.....	24.1	37.9	38.6	32.0	37.1	33.94
March.....	21.9	45.4	34.6	37.9	38.8	35.72
April.....	24.2	36.6	40.2	33.9	32.5	33.48
May.....	24.6	35.5	26.2	37.6	38.7	32.52
June.....	22.1	41.3	39.6	37.3	30.9	34.24
July.....	29.9	27.7	35.5	32.2	30.2	31.10
August.....	25.5	27.4	50.7	21.9	27.3	30.56

TABLE 4

Showing the monthly percentage egg production of Barred Plymouth Rock chickens from 1922 to 1927

MONTHS	YEARS					AVERAGE
	1922-23	1923-24	1924-25	1925-26	1926-27	
September.....	28.1	16.3	9.3	17.1	6.8	15.52
October.....	13.2	18.5	25.6	11.9	23.5	18.54
November.....	4.6	15.5	41.1	20.0	27.0	21.64
December.....	9.3	10.0	18.2	5.3	27.4	14.04
January.....	22.0	21.4	8.6	18.5	26.7	19.44
February.....	22.1	30.7	35.7	43.2	32.2	32.78
March.....	24.4	35.5	37.6	36.1	41.6	35.04
April.....	27.1	30.1	41.2	35.0	32.6	33.20
May.....	24.6	31.3	38.9	36.8	33.1	32.94
June.....	21.3	25.9	24.1	35.2	32.1	27.72
July.....	25.4	28.0	24.1	28.8	30.6	27.38
August.....	17.7	17.7	12.3	23.7	26.7	19.62

TABLE 5

Showing the monthly percentage egg production of Rhode Island Red chickens from 1922 to 1927

MONTHS	YEARS					AVERAGE
	1922-23	1923-24	1924-25	1925-26	a	
September.....	24.4	24.5	2.5	13.6		16.25
October.....	8.9	12.8	12.2	20.9		13.70
November.....	10.0	12.6	22.7	25.0		17.57
December.....	3.4	8.4	20.9	17.6		12.57
January.....	18.8	5.6	24.3	20.6		17.32
February.....	22.8	26.8	21.7	29.3		25.12
March.....	22.1	37.0	25.9	27.2		28.05
April.....	22.3	32.9	33.3	25.0		28.37
May.....	17.9	31.9	37.1	27.4		28.57
June.....	20.0	30.2	30.0	30.0		27.55
July.....	24.3	30.2	41.9	22.6		29.75
August.....	25.8	32.7	28.6	14.1		25.30

^aThe data for the laying year 1926-1927 for this breed was excluded as the number of hens in the pen was less than ten.

TABLE 6^a

Showing the normal egg production of Cantonese, Native, White Leghorn, Barred Plymouth Rock, and Rhode Island Red breeds of chickens expressed in terms of number of eggs expected from each individual each month

MONTHS	NUMBER OF EGGS				
	Cantonese	Native	White Leghorn	Barred Plymouth Rock	Rhode Island Red
September.....	7.2	6.5	4.8	4.7	4.9
October.....	6.6	6.8	6.4	5.7	4.2
November.....	6.4	5.7	8.9	6.5	5.3
December.....	6.1	5.9	6.3	4.3	3.9
January.....	9.1	7.3	9.7	6.0	5.4
February.....	9.6	8.6	9.5	9.2	7.0
March.....	10.2	10.9	11.1	10.9	8.7
April.....	9.4	9.8	10.0	10.0	8.5
May.....	8.8	10.0	10.1	10.2	8.9
June.....	8.1	9.5	10.3	8.3	8.3
July.....	7.7	8.7	9.6	8.5	9.2
August.....	6.0	7.1	9.5	6.1	7.8
Total.....	95.2	95.8	106.2	90.4	82.1

^aComputed from averages of percentage egg production given in tables 1 to 5.

TABLE 7

Showing the seasonal distribution of eggs in the Philippines compared with that in Australia (1924) and United States (1924)

MONTHS	PERCENTAGE EGG PRODUCTION		
	Philippines ^a	Australia ^b	United States ^c
September.....	24.0	56.1*	27.6
October.....	21.2	55.1	20.8
November.....	21.2	53.3	17.0+
December.....	19.6+	47.9	24.8
January.....	29.3	40.6	34.5
February.....	34.2*	38.9	51.7
March.....	33.0	35.4	67.1*
April.....	31.3	26.9+	66.3
May.....	28.5	39.5	61.2
June.....	26.9	50.7	53.6
July.....	22.8	51.2	43.8
August.....	19.2	50.2	32.3

^aFive year average (1922-1927) for the Cantonese breed.

^bVictoria, 1924 data for the Black Orpington breed.

^cNew Jersey, 1922 data for the Barred Plymouth Rock breed.

* Maximum.

+ Minimum.

COMPARATIVE NUTRITIVE VALUES OF DIFFERENT SALTS OF AMMONIUM¹

ELEUTERIO PALISOC

In studying the salt requirements of young rice plants, Espino² found that Shive's³ 3-salt complete culture solution in which nitrogen was employed only as nitrate invariably produced a chlorotic appearance of young rice plants, and growth was stunted, but when ammonium sulfate was added to the culture solution, excellent growth and development of the plants was always obtained. The apparent beneficial effect which the young rice plants derived from the ammonium sulfate makes it of interest to find out what other ammonium compounds may give a similar effect. The object of this study, was to determine the effects of these compounds on young rice plants. It was conducted in the Department of Plant Physiology of the College of Agriculture, during the academic year, 1926-27.

MATERIALS AND METHODS

The young plants

Young rice plants of a lowland variety were used in this study. The seeds were germinated on a piece of paraffined bobbinet stretched horizontally over the wide mouth of a large glass vessel filled to the rim with tap water so that the bobbinet lay on the surface of the water nearly all the time. This level was maintained by frequent additions of water in the vessel.

When the shoot was about six centimeters high, uniformly developed seedlings were selected for the cultures. These seedlings were transferred to the nutrient solutions by fixing each of them in a perforated cork stopper in the manner described by Espino². Each culture had three seedlings,—one seedling to a hole.

The culture solutions

Single-salt stock solutions. The salts used in the cultures were first prepared singly in M/10 concentration. These salts were "Baker analysed" monopotassium phosphate (KH_2PO_4), calcium nitrate ($\text{Ca}(\text{NO}_3)_2$), mag-

¹Part of thesis presented for graduation, 1927, with the degree of Bachelor of Agriculture No. 262; Experiment Station contribution No. 529. Prepared in the Department of Plant Physiology under the direction of Dr. R. B. Espino.

²Espino, Rafael B. 1920. Some aspects of the salt requirements of young rice plants. *Philippine Journal of Science* 16: 455-525.

³Shive, John W. 1915. A study of physiological balance in nutrient media. *Physiological Researches* 1: 327-397.

nesium sulfate (MgSO_4), ammonium sulfate ($(\text{NH}_4)_2\text{SO}_4$), ammonium nitrate, and ammonium phosphate. Distilled water was used as the solvent of all these salts.

Culture solution. The culture solutions were prepared according to the proportions and concentrations of each salt as shown in table 1. Each solution was prepared in the manner described by Espino¹. Sixty-five cubic centimeters of each solution were used as a culture medium; it was placed in a glass bottle about eight centimeters high and with a gross diameter of four centimeters. Each culture was run in duplicate for 21 days and renewals of solution were made every three days. Two trials were run for each salt series, except the control series in which four trials were made and three salts series were run simultaneously, so that in a given experimental period there were 54 cultures; 24 cultures for each of the two salt series and six bottles for the control. The culture series may be described briefly as follows:

Ammonium nitrate series. This was a combination of monopotassium phosphate, ammonium nitrate, calcium nitrate, and magnesium sulfate, with ammonium nitrate in varying amounts.

Ammonium phosphate series. This was a combination of monopotassium phosphate, mono-ammonium phosphate, calcium nitrate, and magnesium sulfate, with mono-ammonium phosphate in varying amounts.

Ammonium sulfate series, or control series. This is the so-called Espino's best 4-salt solution type A employed here as control and also as a series of cultures by itself. This is a combination of monopotassium phosphate, ammonium sulfate, calcium nitrate and magnesium sulfate in the proportions of these salts as shown in table 1.

No other salt of ammonium was tried as there was no other that could be used without introducing into the culture medium a non-essential element. For example, ammonium chloride was not used because it would add chlorine to the culture solution.

EXPERIMENTS AND RESULTS

In the ammonium nitrate and the mono-ammonium phosphate series six cultures, (cultures 5 and 6 under groups A, B, and C, see table 1) were not run in the first trial, and another six cultures (cultures 1 and 2 under groups A, B, and C) were not run in the second trial. The reason for this was that in the first trial when the heaviest yield of dry weight of plants was produced by those growing in the highest concentrations in each group, additional solutions of still higher concentrations were run so as to find the optimum concentration for the growth and development of rice plants. Such being the case, the two lowest concentrations in each group run in the first trial that did not seem to be good for the young plants were not included in the second trial, and in their stead in each group, there were carried two concentrations higher than any included in the first trial. The

control cultures, or what may be considered as the ammonium sulfate series, were always included in the other ammonium salt sets.

To determine the relative beneficial effects of the different media upon the growth and development of the young rice plants, the following criteria of results were used:

External appearance of plants. The external appearance of the plants was carefully noted from time to time. The color of the leaves and stalks was noted, together with any injury in any part of the plants. The observations taken at the time of harvest were recorded, and are on file in the Department of Plant Physiology; they are not included in this paper for lack of space.

Measurement of growth. Before harvesting the plants at the end of an experimental period, the full lengths of the roots and the top of each culture were measured separately. The data thus obtained are not here presented, except those for the best culture from each salt series (see table 2).

Dry weights of plants. After harvesting, the plants were wrapped separately by cultures with paper and then dried in an electric oven. Then they were weighed and the data recorded but not here presented, except those for the best culture for each salt series (see table 2).

The control cultures. The results of the best of the control cultures are also recorded in table 2.

DISCUSSION OF RESULTS

In attempting to solve the problems on hand, a substitution method was employed. A radical attached to one metal was substituted for another radical and a metal with one radical was substituted for another metal attached to the same kind of radical in Espino's solution of 4-salt type A. For example, in the ammonium nitrate and the ammonium phosphate series, all the salts in Espino's solution of 4-salt type A were included except the ammonium sulfate, which was replaced by ammonium nitrate in the ammonium nitrate series and by ammonium phosphate in the ammonium phosphate series. Care was taken that in the process of substitution no element essential for the normal growth and development of plants was omitted, nor was an element or elements not included in the 4-salt type A of Espino's solution introduced. The different salt series were first studied separately and the culture solution found best in each series is here used in making the comparative nutritive values.

The cultures in the ammonium nitrate series

Examination of the data, which for lack of space are not here printed, showed that the plants grown in the cultures in the ammonium nitrate series were normally developed. In fact, some of the cultures of this series were better than the control.

Arbitrarily selecting from each of the two trials the cultures that gave the three highest records on: (a) the height of top, (b) length of root, and (c) the weight of dry plants, it was found that primarily under the last criterion of results and supported by the highest record under either or both of the other two criteria, that the culture $\text{B-NH}_4\text{NO}_3\text{-4}$ was the best in this series. This culture was found to have given the best result in both trials and was characterized by having 1 part KH_2PO_4 ; 4 parts NH_4NO_3 ; 2 parts $\text{Ca}(\text{NO}_3)_2$; and 4 parts MgSO_4 , with a total concentration of 0.00275 gram-molecule (of all the salts taken together) per liter.

The cultures in the mono-ammonium phosphate series

As shown by the data recorded but not here published, the plants grown in the cultures in the mono-ammonium phosphate series were fairly well developed as to tops and roots and had very dark green leaves and culms, but these plants had leaves with dried tips. This injury was plainly observed on the plants grown in the culture solutions containing the higher partial concentration of mono-ammonium phosphate.

Arbitrarily selecting the cultures from each trial yielding the three consecutive highest yields or records under each of the criteria of results here employed, it was found that the culture $\text{B-NH}_4\text{H}_2\text{PO}_4\text{-4}$ gave the best plants in both trials. This culture was characterized by having 1 part KH_2PO_4 ; 4 parts $\text{NH}_4\text{H}_2\text{PO}_4$; 2 parts $\text{Ca}(\text{NO}_3)_2$; and 4 parts of MgSO_4 , with a total concentration of 0.00275 gram-molecule (of all the salt taken together) per liter.

The cultures in the ammonium sulfate (control) series

The data obtained from the three cultures in which ammonium as sulfate was supplied the young rice plants showed that the culture solution made up of one part each of monopotassium phosphate, ammonium sulfate, and calcium nitrate and five parts of magnesium sulfate with a total concentration of 0.002 gram-molecule (of all the salts taken together) per liter was the best. This finding corroborates Espino's results (see footnote) and the data obtained from this culture medium are here used in making the comparative nutritive values of the three forms of ammonium salts.

The best culture from each series compared

The best culture from each of the three ammonium salts series tried—the NH_4NO_3 -series, the $\text{NH}_4\text{H}_2\text{PO}_4$ -series, and the $(\text{NH}_4)_2\text{SO}_4$ -series,—were compared. For this purpose and for the sake of clearness these best cultures were compiled from the data on hand and are presented in table 2.

Examination of table 2 shows that in term of the dry weight of the plant, the control, or the best culture from the $(\text{NH}_4)_2\text{SO}_4$ -series was surpassed by the best culture in the NH_4NO_3 -series by at least 25 per cent. This difference indicates that the ammonium ion was more beneficial to the

young rice plants when attached to the nitrate radical than when it was attached to the sulfate radical.

Further, the data in table 2 also show that the phosphate of ammonium was harmful to the young rice plants; for although the plants were apparently fairly well developed in the cultures which contained this salt, yet the leaves were dry at the tips,—a physiological disturbance similar to that observed by Espino when the $\text{Ca}(\text{NO}_3)_2$ was replaced by the monobasic calcium phosphate, $(\text{Ca}(\text{H}_2\text{PO}_4)_2 \cdot \text{H}_2\text{O})$ in a complete culture solution (see footnote).

The relative nutritive values of the different salts of ammonium tested may be tentatively be given as follows: NH_4NO_3 was the best; $(\text{NH}_4)_2\text{SO}_4$ was next best; and the $\text{NH}_4\text{H}_2\text{PO}_4$ was the poorest, or most unsuitable for the young rice plants as this salt always gave a characteristic physiological injury,—drying of the tips of the leaves. The culture solution found best suited for the growth and development of the young rice plants was characterized by having 1 part KH_2PO_4 ; 4 parts NH_4NO_3 ; 2 parts $\text{Ca}(\text{NO}_3)_2$; and 4 parts MgSO_4 with a total concentration of 0.00275 gram-molecule (of all the salts taken together) per liter.

SUMMARY OF CONCLUSIONS

Under the conditions of this study, it was found that:

1. Of all the ammonium salts tried, NH_4NO_3 was the best; $(\text{NH}_4)_2\text{SO}_4$ was next best; and $\text{NH}_4\text{H}_2\text{PO}_4$ was the poorest, as it always produced a characteristic physiological injury,—drying of the tips of the leaves of the young rice plants.

2. A new culture solution nutritively better than Espino's best 4-salt solution type A was found and characterized by having 1 part KH_2PO_4 ; 4 parts NH_4NO_3 ; 2 parts $\text{Ca}(\text{NO}_3)_2$; and 4 parts MgSO_4 with a total concentration of 0.00275 gram-molecule (of all the salt taken together) per liter.

TABLE 1

Salt proportions and total concentration of all the salt series

SALT SERIES	CULTURE DESIGNATION	SALT PROPORTION: GRAM MOLECULE OF EACH SALT PER LITER				CONCENTRATION OF CULTURE SOLUTION: GRAM-MOLECULE OF ALL SALTS TAKEN TOGETHER PER LITER
		KH ₂ PO ₄	NH ₄ NO ₃	Ca(NO ₃) ₂	MgSO ₄	
Ammonium nitrate	A—NH ₄ NO ₃ -1	.00025	.000125	.00025	.00125	0.001875
	-2	.00025	.00025	.00025	.00125	0.002
	-3	.00025	.0005	.00025	.00125	0.00225
	-4	.00025	.001	.00025	.00125	0.00275
	-5	.00025	.002	.00025	.00125	0.00375
	-6	.00025	.004	.00025	.00125	0.00575
	B—NH ₄ NO ₃ -1	.00025	.000125	.0005	.001	0.001875
	-2	.00025	.00025	.0005	.001	0.002
	-3	.00025	.0005	.0005	.001	0.00225
	-4	.00025	.001	.0005	.001	0.00275
	-5	.00025	.002	.0005	.001	0.00375
	-6	.00025	.004	.0005	.001	0.00575
	C—NH ₄ NO ₃ -1	.00025	.00025	.00025	.001	0.00125
	-2	.00025	.0005	.00025	.001	0.002
	-3	.00025	.001	.00025	.001	0.0025
	-4	.00025	.002	.00025	.001	0.0035
	-5	.00025	.004	.00025	.001	0.0055
	-6	.00025	.008	.00025	.001	0.0095
		KH ₂ PO ₄	NH ₄ H ₂ PO ₄	Ca(NO ₃) ₂	MgSO ₄	
Ammonium phosphate	A—NH ₄ H ₂ PO ₄ -1	.00025	.000125	.00025	.00125	0.001875
	-2	.00025	.00025	.00025	.00125	0.002
	-3	.00025	.0005	.00025	.00125	0.00225
	-4	.00025	.001	.00025	.00125	0.00275
	-5	.00025	.002	.00025	.00125	0.00375
	-6	.00025	.004	.00025	.00125	0.00575
	B—NH ₄ H ₂ PO ₄ -1	.00025	.000125	.0005	.001	0.001875
	-2	.00025	.00025	.0005	.001	0.002
	-3	.00025	.0005	.0005	.001	0.00225
	-4	.00025	.001	.0005	.001	0.00275
	-5	.00025	.002	.0005	.001	0.00375
	-6	.00025	.004	.0005	.001	0.00575
	C—NH ₄ H ₂ PO ₄ -1	.00025	.00025	.00025	.001	0.00175
	-2	.00025	.0005	.00025	.001	0.002
	-3	.00025	.001	.00025	.001	0.0025
	-4	.00025	.002	.00025	.001	0.0035
	-5	.00025	.004	.00025	.001	0.0055
	-6	.00025	.008	.00025	.001	0.0095
		KH ₂ PO ₄	(NH ₄) ₂ SO ₄	Ca(NO ₃) ₂	MgSO ₄	
Ammonium sulfate (Control)	A	.00025	.00025	.00025	.00125	0.002
	B	.00025	.00025	.0005	.001	0.002
	C	.00025	.0005	.00025	.001	0.002

TABLE 2
Comparing the data obtained from all the "best" cultures *a* (Compiled from data not presented in this paper)

DATE OF EXPERIMENTS	CULTURE DESIGNATION	SALT PROPORTION	HEIGHT OF TOP ^b	LENGTH OF ROOT ^b	WEIGHT OF DRY TOP AND ROOT ^b	EXTERNAL APPEARANCE OF PLANTS
October 21	B—NH ₄ NO ₃ —4	1 part KH ₂ PO ₄ 4 parts NH ₄ NO ₃ 2 " Ca(NO ₃) ₂ 4 " MgSO ₄	121	126	125	Plants dark green; vigorous; plenty of roots
to	B—NH ₄ H ₂ PO ₄ —4	1 part KH ₂ PO ₄ 4 parts NH ₄ H ₂ PO ₄ 2 " Ca(NO ₃) ₂ 4 " MgSO ₄	110	124	107	Plants fairly well developed, normal green, tips of leaves dried
November 11	Control	1 part KH ₂ PO ₄ 1 " (NH ₄) ₂ SO ₄ 1 " Ca(NO ₃) ₂ 5 parts MgSO ₄	100 (58.9 cm.)	100 (24.6 cm.)	100 (.247 gram)	Plants normal
1926	B—NH ₄ NO ₃ —4	1 part KH ₂ PO ₄ 4 parts NH ₄ NO ₃ 2 " Ca(NO ₃) ₂ 4 " MgSO ₄	103	102	132	Plants dark green; vigorous; plenty of roots
to	B—NH ₄ H ₂ PO ₄ —4	1 part KH ₂ PO ₄ 4 parts NH ₄ H ₂ PO ₄ 2 " Ca(NO ₃) ₂ 4 " MgSO ₄	105	98	103	Plants fairly well developed; normal green; tips of leaves dried
December 31	Control	1 part KH ₂ PO ₄ 1 " (NH ₄) ₂ SO ₄ 1 " Ca(NO ₃) ₂ 5 parts MgSO ₄	100 (66.4 cm.)	100 (28.0 cm.)	100 (.33 gram)	Plants normal
1926						

^aThe culture giving the highest yield of dry weight of tops from each trial, or set of cultures is the "best" culture.

^bThe data are in relative values; the highest actual value under each criterion was arbitrarily taken as 100, the other actual values were reduced relatively.

NOTE: INTRODUCED COFFEES LOSE RESISTANCE TO THE
RUST FUNGUS *HEMILEIA VASTATRIX* BERKELEY AND
BROOME¹

PEDRO A. DAVID

Of the Department of Agronomy

The coffee rust-fungus *Hemileia vastatrix* B. and Br. is responsible for the failure of the Arabica coffee in the Philippines. The disease became serious in 1889 and destroyed many coffee plantations in Batangas Province. Just how and when the coffee rust was introduced into the Philippines is not known.

In an effort to obtain rust-resistant coffee for the Philippines Professor C. F. Baker of the College of Agriculture, at Los Baños and Messrs. C. C. Batchelder formerly with the Philippine Government and P. J. Wester of the Philippines Bureau of Agriculture, during the period from 1910 to 1916, introduced into these Islands different varieties of supposedly rust-resistant Arabian, Liberian, and Robusta types of coffee from Java and other countries of the world. Two plants of Kawisari B coffee hybrid, the most rust-resistant so far observed in Java were brought in August, 1927, to the College of Agriculture from Java by Dr. N. B. Mendiola of the Agronomy Department. These plants are now growing well in Doctor Mendiola's private collection. Seeds of Kawisari A and Kawisari D were introduced by Doctor Mendiola in January 24, 1924, but they failed to grow. The varieties introduced into the College of Agriculture are given in table 1.

After these different types of coffee were introduced into the College of Agriculture the work of searching for rust-resistant varieties was begun. It was thought that better results could be obtained by planting the introduced coffees at different altitudes. From 1914 to 1916 experimental plantations were opened at different elevations as given in table 2.

The three experimental plantations were given practically the same field treatment. They were not fertilized. From 1918 to 1926 the Division of Coffee, Cacao and Spices of the Department of Agronomy of this College counted the coffee trees of each type of coffee at different altitudes and examined the leaves of individual plants for rust-infection.

In 1921 all of the Arabica trees in the Plateau Plantation were completely defoliated by the rust while the Robusta and Liberian types did not show signs of infection. From 1923, however, the Liberian and Robusta

¹Experiment Station contribution No. 530. Received for publication January 12, 1928.

types showed trees infected with *Hemileia vastatrix*². It seems that constant exposure to inoculum for a number of years renders even the highly resistant species or varieties of *Coffea* susceptible to the rust fungus. The summary of the results of this study is given in tables 3 and 4.

From the work on coffee at this College the following statements can now be made with some degree of certainty:

1. All introduced varieties of coffee belonging to the Arabian, Robusta, and Liberian types are subject to the attack of the coffee rust-fungus *Hemileia vastatrix*.

2. Altitudes from 80 to 450 meters above sea level do not affect the relation of Arabian, Robusta, and Liberian types of coffee to the rust fungus.

3. All coffee trees under shade of madre-cacao (*Gliricidia maculata*), ipil-ipil, (*Leucaena glauca*) and anii (*Erythrina fusca*) are more vigorous in their growth and less affected by the rust than those not shaded. This observation seems to be in accord with those of Fromme³ who found that *Puccinia coronifera* does not develop on its host in the absence of light; and Mains⁴ who reported that the development of *Puccinia coronata* and *P. sorghi* on their hosts is retarded or stopped because of the lack of carbohydrates in the absence of light or of carbon dioxide.

4. The Arabian type is the most seriously infected and the Liberian type the least. When the Robusta, Arabica, and Liberica types are grown side by side the Arabian coffee succumbs first to the rust. Robusta coffees seem to be intermediate between the Arabica and Liberica coffees in their susceptibility to the *Hemileia vastatrix*.

5. Observations at this College show that it is not advisable to extend our college plantings of the imported and supposedly rust-resistant Robusta and Liberica coffees at the present time. The writer noted that a prolonged exposure of these types of coffee to infection render them susceptible to rust and it is believed that sooner or later their fate would be the same as the old Arabian type and careful search for rust-resistant hybrids should now be undertaken.

²Determination by G. O. Ocfemia, Department of Plant Pathology.

³Fromme, F. D. 1913. The culture of cereal rusts in the greenhouse. Bulletin of the Torrey Botanical Club 40: 501-521.

⁴Mains, F. B. 1917. The relation of some rusts to the physiology of their hosts. Amer. Jour. Bot. 4: 179-220.

TABLE 1

*Types of coffee introduced into the College of Agriculture
Arabian Type*

COLLEGE NO.	VARIETY NAME	DATE OF INTRODUCTION	SOURCE OF ORIGIN
07	D. 1. 1. D. 1. 1.	Jan. 15, 1910	Y. 1. 1.

TABLE 2

Showing elevations and annual rainfall at the different altitudes where the three types of introduced coffee were planted

PLANTATION	ELEVATION	AVERAGE ANNUAL RAINFALL ^a	NUMBER OF TREES PLANTED		
			Arabica	Robusta	Liberica
	<i>meters</i>	<i>mm.</i>			
Mount Maquiling	450	2619.2	464	490	111
Plateau	100	2139.7	1600	7301	100
College Farm	80	2139.7	200	284	38

^aThe record of the rainfall was obtained from the Department of Plant Physiology, College of Agriculture. The rainfall on Mount Maquiling is an average obtained for 1918 to 1921. The rainfall on the Plateau and College Farm is an average for 1918 to 1926.

TABLE 3

Showing a summary of yearly observations from 1918 to 1926 on the relation of different varieties of coffee at different altitudes to infection by Hemileia vastatrix

TYPES	PLANTATION	NUMBER OF TREES STUDIED		PERCENTAGE OF INFECTED TREES
		Affected	Not affected	
Arabian	Mount Maquiling	441	23	95.0
Robusta	Mount Maquiling	431	59	88.0
Liberica	Mount Maquiling	12	99	10.8
Arabian	Plateau	1600	00	100.0
Robusta	Plateau	584	6717	8.0
Liberica	Plateau	00	10	0.0
Arabian	College Farm	200	00	100.0
Robusta	College Farm	142	142	50.0
Liberica	College Farm	4	35	10.3

NOTE:—Observations were made during the latter part of September and early part of October.

TABLE 4

Showing the relation of the different varieties of coffee at different elevations to infection by Hemileia vastatrix in 1927

TYPES	PLANTATION	NUMBER OF TREES STUDIED		PERCENTAGE OF INFECTED TREES
		Affected	Not affected	
Arabica	Mount Maquiling	8	0	100
Robusta	Mount Maquiling	26	13	67
Liberica	Mount Maquiling	32	22	59
Arabica	Plateau	dead	dead	dead
Robusta	Plateau	2017	576	78
Liberica	Plateau	70	15	82
Arabica	College Farm ^a	11	0	100
Robusta	College Farm	285	80	78
Liberica	College Farm	64	108	37

^aReplanting was made on the College Farm.

NOTE:—Observations were made during October and November.

EXTENSION DIVISION NOTES

Prepared by Moises M. Kalaw under the supervision of Prof. Inocencio Elayda

A Popular Cover Crop

Cover cropping is not a very old practice in the Islands. In fact there is hardly any plant in the Philippines which may be called an ideal cover crop. At present a plant supposed to have come from Java several years ago is attracting the attention of farmers. The scientific name of the plant is *Tephrosia candida*, but it is popularly known as Teprosia. The plant though essentially a cover crop is being used in several ways. Since it is a legume it is used very effectively as a soil renovator especially in sugar cane districts. It is used in the eradication of cogon in coconut plantations and at the same time it serves as a cover crop for the coconuts. Teprosia has been proved to be a very excellent cover crop for orchards, especially for citrus. Actual results of its effectiveness as a cover crop for citrus can be seen in the Tanawan Citrus Experiment Station. Recently, it has been found in Batangas that it can be used as a cover crop and at the same time a temporary shade for coffee. So with the agitation for the revival of the coffee industry in Batangas which is attracting the attention of the local press, the use of Teprosia as a shade is always linked. There is a very great demand for seeds.

The popularity of Teprosia is owing to its several good qualities. It is a very fast grower. It is not eaten by farm animals. It is very robust, so it kills the weeds growing under it. It grows to an ideal height for a shade and for a cover crop. Its wood is not hard as is the ipil-ipil so that it can be cut very easily when it is no longer needed. It is very easy to grow. And lastly it produces seeds in great quantities. Such qualities adapt it to Philippine conditions.

Provincial Carnivals

At the present writing two of the wealthy provinces of the Philippines, Laguna and Occidental Negros are holding provincial carnivals. The one in Laguna is in San Pablo, and that of Negros in Bacolod. The holding of such carnivals ought to be encouraged, because they are places of amusement and at the same time have some instructional value. The authorities concerned should be more interested in the serious objects of the carnival, promotion of agriculture and sanitation. If managed properly it should be a means by which business and agricultural enterprises could be promoted. It should not be a display only of beautiful ladies of the province, but rather an exposition of what the province has done, will do, and is doing to promote economic development.

A Successful Farm Demonstration

A few weeks ago a demonstration was held in Pila, Laguna of a threshing machine taken from the College of Agriculture. Professor Raymundo of the College demonstrated the efficiency of the threshing machine in threshing rice as compared to the native method. The people of Pila were very satisfied with the machine. Professor Raymundo says he would not be surprised to find a similar machine in operation in Pila next year. The people found that the machine was really a labor-and-money-saving device. The capacity of the machine a day is equivalent to the work of fifty men. The expenses incurred by using the machine is only about half as much as when human labor is used.

BE THE BEST OF WHATEVER YOU ARE

If you can't be a pine on top of the hill
Be a scrub in the valley—but be
The best little scrub by the side of the rill,
Be the bush if you can't be a tree;
If you can't be a bush be a bit of the grass
Doing something for somebody's sake;
If you can't be a muskie then just be a bass,
But the liveliest bass in the lake.
We can't all be captains, some have to be crew.
There's something for all of us here,
There's big work and little for people to do,
And the task we must do is the near.
If you can't be a highway then just be a rail,
If you can't be the sun be a star.
For it isn't by size that you win or you fail—
Be the best of whatever you are.

—DOUGLAS MALLOCH.

Nature is ever making signs to us, she is ever whispering to us the beginnings of her secrets; the scientific man must be ever on the watch, ready at once to lay hold of nature's hint, however small, to listen to her whisper, however low.

—M. FOSTER.

EXCHANGE NOTES

Very recently eighteen master farmers in the state of Oklahoma were feted at a dinner given in their honor in the capital city of that state. These were men who had been nominated by their neighbors and chosen by appointed judges as exemplars to the farmers of the country. In becoming members of this select group, which numbers more than 200 throughout the country, the work of these men as farmers had to pass critical inspection; the general appearance of their farms and buildings, the preparation and upkeep of the soil, the housing and general care given their implements, their business methods, and the home life of their families and their standings in their respective communities were given merciless examination. When admitted to this group, each one had reason to feel justly proud of the honor thus conferred upon him.

—*Butter, Cheese & Egg Journal* (Wisconsin).

Art Meyers, Valley county, Nebraska, grows 100 acres of popcorn annually. The most difficult task, husking, is handled by a mechanical corn picker. Mr. Meyers' machine is drawn by a tractor and shucks 7 to 9 acres a day.

It costs no more to grow an acre of popcorn than of field corn, according to Mr. Meyers and the returns usually are much better. One year he had 250 acres which yielded well and the price was 7 cents a pound. The crop brought \$28,000. He grows one half of the baby rice variety and one half of the big rice variety. The baby rice yields less but brings a higher price. Meyers is using alfalfa and sweet clover in keeping his popcorn soils fertile.

—*Capper's Farmer* (Kansas).

If we had paid no more attention to our plants than we have to our children, we should now be living in a jungle of weeds.—LUTHER BURBANK.

—*Journal of Education* (Wisconsin).

According to a recent press report, the problem of commercial utilization of maizestalks is believed to have been solved after many years of effort. The process of Dr. Bela Dorner, a Hungarian chemist, has been brought to the United States, tested by experts, and pronounced practicable and economical. By this method artificial silk has been produced from maizestalk pulp. The technical obstacles have been the pith and knuckle of the stalks, which could not be removed economically. The Dorner process grinds up the entire stalk, which means that it is possible to convert a waste material into abundant supplies of pulp for making paper, artificial

silk, motion-picture films, explosives, celluloid, lacquers, artificial leather, pyralin, and other products. Now the maize belt farms destroy annually more than enough stalks to supply the pulp requirements of the United States. By-products of the Dorner process can be used in the manufacture of alcohol, cattle feed, butanol, furfural, lactic acid, &c. These by-products will be an additional revenue.

—*The Journal of Agriculture*, Australia (Victoria).

The whole endeavour of the farmer to-day is to produce, and to breed with that object in view. It is impossible to dissociate these two things—breeding and feeding. When animals are bred up to heavy production they must be fed in proportion to their capabilities. In order to exhibit their abilities the best of milk-producers require the feed to convert into milk. The same principle applies to pigs. No matter from how economical a strain they may be they will never fatten if not adequately fed. Domesticated farm-stock are living machines, converting vegetable materials (chiefly) into food suitable for human consumption. The more they are expected to give, the more and richer the crude products fed to them must be. Farm-stock convert food unsuitable for human consumption into suitable food.

—*Journal of Agriculture* (New Zealand).

Growers of pineapples in Hawaii have suffered in recent years by the fruits falling off in flavour on some of the plantations. Scientific examination led to the belief that the cause was a deficiency of manganese; additions of manganese salts were therefore made, and the trouble is said to have been in great part remedied.

—*Agricultural Gazette* (New South Wales).

***“Wherever production exceeds consumption, there is progress; where consumption exceeds production, there is retrogression.” In New England, each generation has left the country richer than it found it.

—*The American Review of Reviews* (New York).

The most economical source of nitrogen for cornbelt conditions is that obtained through the growth of legumes. Since legumes alone are powerless to add nitrogen to the soil but must have the help of friendly microbes which live in the nodules on their roots, it is apparent that care should be taken to insure the growth of inoculated legumes on the land.

An acre of soybeans will fix as much nitrogen as is contained in eight tons of stable manure.

—*Prairie Farmer* (Illinois).

In the five years from 1920 to 1924 nearly 10,000,000 orange trees were planted in Florida, where the number of trees bearing fruit in 1924 numbered only 7,306,000.

—*Journal of Agriculture* (Victoria).

COLLEGE AND ALUMNI NOTES

Mr. Shunzo Takano, entomologist of the Sugar Experiment Station, Shinkwa, Formosa, recently came to the College. He is intending to stay four months, for the purpose of rearing and introducing into Formosa the tachinid parasites which Doctor Uichanco had reported on *Laspeyresia schistaceana* Sn., one of the most important moth borers of the sugar cane in southern Luzon.

Doctors M. L. Roxas, N. B. Mendiola, R. L. Pendleton, and L. B. Uichanco were invited to read papers at the Planters' Day meeting on April 12, 1928, one of the special features of the Negros Carnival. Doctors Roxas and Uichanco were the only ones of the four able to accept the invitation.

Assistant Professors Margaret Wilson and Marcia Whipple of the Department of English sailed in April for the United States via Europe. Miss Wilson will enter the University of Wisconsin for graduate study in September. She will also carry some classes as instructor in English in the same institution.

On April 3, 1928, at the request of Regent Arturo Garcia, Dr. R. B. Espino went to Santa Cruz, Zambales, to make an agricultural survey of the island "Hermana Mayor" recently acquired by purchase by Doctor Garcia. Doctor Espino returned to the Campus on April 6, 1928. Commenting on this survey, Dean Gonzalez said, "It seems to me this is the kind of extension best fitted for the College—for people to solicit our services rather than for us to "fire" them at them. The first is appreciated; the second is not, most of the time."

During the College year 1927-1928 twenty-two scientific papers were read before the Los Baños Biological Club. These papers were grouped as follows:

Agricultural Economics.....	1
Agronomy.....	7
Animal Husbandry.....	3
Chemistry.....	2
Entomology.....	2
Plant Pathology.....	1
Plant Physiology.....	2
Veterinary Science.....	4

Dr. R. B. Espino was elected President and Dr. Valente Villegas secretary of the Club for the College year 1928-29.

The College of Agriculture Class of '28 numbers 49.

The Degree of Bachelor of Agriculture
(General Curriculum)

Anselmo Agbanlog, Balungao, Pangasinan
 Gregorio Albino, San Pablo, Aliaga, Nueva Ecija
 Amado A. Andrada, Carles, Iloilo
 Julian A. Belo, Capiz, Capiz
 Lucio Blanco, Bangued, Abra
 Catalino Buligan, Tubigan, Bohol
 Melanio Calinisan, Mendez, Cavite
 Felipe Cortez, Milagros, Masbate
 Juan B. Fandiño, Alaminos, Laguna
 Eliseo V. Hernandez, Paombong, Bulacan
 Filemon Leus, Tanauan, Batangas
 Domingo Limbo, San José, Batangas
 José R. Mozo, Tarangnan, Samar
 Ramón C. Ordoveza, Santa Cruz, Laguna
 Lorenzo G. Paderna, Peñaranda, Nueva Ecija
 Feliciano Pantaleon, San José, Nueva Ecija
 Juan Pegiña, Indang, Cavite
 Hermenegildo G. Protacio, Pasay, Rizal
 Sisenando Reantaso, Oas, Albay
 Dominador Z. Rosell, Alfonso, Cavite
 Rafael B. Rotor, Santa Mesa, Manila
 Baldomero C. Salinas, Manaoag, Pangasinan
 Sixto Sison, Taal, Batangas
 Francisco G. Toribio, Carmen, Bohol
 Teodoro M. Velasco, San Carlos, Pangasinan
 Gaudencio A. Ventura, Mangaldan, Pangasinan
 Felix Foranil Villa, Indang, Cavite

The Degree of Bachelor of Science in Agriculture
(General Curriculum)

Roberto C. Betia, Iloilo, Iloilo
 Salvador Bolivar, Batan, Capiz
 Ignacio Carulla, Natividad, Pangasinan
 Moises P. Castro, Concepción, Tarlac
 Felix G. Gines, Narvacan, Ilocos Sur
 Marcelo B. Peña, Tabaco, Albay
 Teodoro N. Pepito, Lilo-on, Cebu
 Roem Purnariksha, Bangkok, Siam
 Angel H. Severino, Silay, Occidental Negros
 Charuñā Suebsueng, Pattani, Siam
 Charas S. Sundarasinha, Bangkok, Siam
 Simplicio Tiglao, Mabalacat, Pampanga

The Degree of Bachelor of Science in Agriculture
(Supplementary Curriculum)

Tomás Bandong, B. Agr., San Carlos, Pangasinan
Valeriano C. Calma, B. Agr., Bacolor, Pampanga
Mateo D. Jimenez, B. Agr., Talavera, Nueva Ecija
Emilio M. Macasaet, B. Agr., Lipa, Batangas
Zósimo T. Montemayor, B. Agr., Alaminos, Pangasinan
José C. Ramos, B. Agr., Hagonoy, Bulacan

The Degree of Bachelor of Science in Agriculture
(Sugar Technology Curriculum)

Ernesto R. Montinola, San Enrique, Occidental Negros
Delfin Suerte, Santa Barbara, Iloilo

The Degree of Bachelor of Science in Sugar Technology
Atanacio S. Hizon, San Fernando, Pampanga
Ernesto R. Montinola, San Enrique, Occidental Negros

The Class '25 medal for Best Thesis was awarded to Catalino Buligan. His thesis was on "The Corn borer *Pyrausta nubelalis* Hübner." It was prepared under the direction of Dr. L. B. Uichanco.

The Secretary for the College of Agriculture reports on April 10, 1928, as follows on the Summer Session:

	<i>Enrollment</i>	
	1927	1928
Old students.....	308	244
New students.....	34	34
High School graduates.....	(13)	(11)
Intermediate School graduates.....	(21)	(23)
Cross registrants, College of Veterinary Science.....	(8)	(6)
Special poultry husbandry course.....	14	8
Total.....	356	286

Enrollment for Summer Sessions from 1921-28 1921, 200; 1922, 299; 1923, 357; 1924, 366; 1925, 306; 1926, 294; 1927, 356; 1928, 286.

Mr. Bousman, Student Pastor, Union Church and Mr. Tongko, "Y" Secretary, provided a series of lively, entertaining evenings for the students during the week of registration for Summer School. As a leader into the serious work of the summer, the last evening was a lecture on Japan illustrated with stereopticon views.

A Literary Reading Circle among the graduate assistants has been formed. This group meets every fortnight for the purpose of reading aloud and discussing books and articles, serious or otherwise, that are in no way connected with their professional work. There are about twenty members. They meet quite informally: the object being to maintain and cultivate interest in literature of the present day and the past.

WHAT A UNIVERSITY SHOULD DO FOR ITS STUDENTS

*(Extracts from the Inaugural Address on February 22, 1928, of
Dr. M. Lyle Spencer, President of the University of Washington, Seattle)*

. It is a solemn, a sacred duty, this assumption of authority to direct the destinies, even for four years, of more than seven thousand young men and women. No man can have a higher or more consecrated mission than this; for the lives of the youth of our state are dearer to us than all the treasure America possesses. One stands in awe at the responsibility and the latent possibilities. Generations are unborn whose lives shall be affected by the character of the education we offer on our campus, and the very destiny of our state may be altered by our varying curricula. We have reason, therefore, to regard this hour as sacred. . . .

No university is a university other than in name unless the spirit of research, the ardent quest for the unknown, permeates its faculty. The staff of a real university is, to use the fine phrase of ex-President Eliot, "a guild of scholars," mutually encouraging and supporting each other in fired and emulous devotion to the discovery of truth. The active spirit of research in a university keeps a faculty young and virile. It inspires and disciplines those chosen few who are to be the intellectual leaders of society. And save for the rare individual who is weaned away from human sympathies and contacts by his study or his laboratory, it vitalizes and vivifies the teaching of even the most elementary courses.

The University of Washington would fail in its contribution to society if it did not meet the pressures for advanced study as they present themselves. It must accept its full share in the work of training research men in the fields of pure and applied knowledge, and of preparing men for teaching in institutions of higher learning. We must not fail the commonwealth or the nation in either of these obligations, for in the faithful discharge of them is implied the perpetuity and advance of American civilization. Our University must aspire, therefore, to a well-balanced graduate school.

On the other hand, there are certain fields of research in which special and prior responsibility rests upon us by virtue of our location, and in which the scientific world at large has particular claims upon us. Our distinctive province for research must logically be in those fields where natural advantages accrue to us by reason of our geographical location and where greatest returns, both spiritual and material, may be had for those who are supporting us with their tax monies. Among these fields may be enumerated: Northwest history, Northwest anthropology, Oriental history and Oriental

trade, international relations, the geology and biology of the Northwest and of Alaska, hydraulic and electrical engineering, aeronautics, fisheries, and forestry. . . .

One feels a need for this most uncommon trait called common sense in solving many of the problems of undergraduate education. Among these may be noted our phenomenal increase in enrollment, the attendant criticism of mass production in education, the continuing cry of over-emphasis on athletics, and the equally old questioning as to the place of vocational education in the curriculum. All these problems are pressing on us at the University of Washington. And while one naturally hesitates to postulate any general solution, there are a few broad principles that may be laid down for this university.

One of these principles relates to our gain in under-graduate attendance. We have this year the largest enrollment in our history, and one of the major increases among the universities of the West. Despite the popular fear regarding the number of students going to college, and the consequent occasional threat to limit attendance, common sense tells us we are going to provide an education for every son and daughter in the State of Washington who wants it sincerely and who has the mental capacity to receive it. There may be complaints—we expect them always—but education will be provided by the State of Washington for those who deserve it, no matter in what numbers the students come.

Common sense, however, tells us that we have been giving the stamp of a university education to too many youths whose mental capacity has not reached beyond the freshman or sophomore year. We must plan our university curriculum—and that promptly—to take care of those who cannot continue beyond the first or second year, or who are not entitled to do so; and then we must see to it that such students, having been accurately appraised, stop there. To every boy or girl an opportunity, but to no boy or girl an opportunity beyond his deserts.

When this is done, we shall not be bothered with cries of mass production in education, about which so much loose and sometimes meaningless talk has been made. Mere numbers do not constitute mass production in the sense that the term is applied to automobiles or furniture or harvesting machines. Thousands may be educated as readily as hundreds, and as individually. More individually indeed, for where numbers are, the opportunities for clash of mind upon mind and for diversity of choice both of instructors and subjects are the greater. And where these conditions exist, the entire tendency is away from uniformity, which is what mass production implies.

Common sense tells us, too, that our University, if it expects to maintain its place of prestige in the state—if, indeed, it expects to exist at all—must represent the life of the commonwealth and must minister to that life. President Butler of Columbia made the following significant statement

something more than thirty years ago: "When the universities in any country cease to be in close touch with the social life and institutions of the people, and fail to yield to the efforts of those who would readjust them, their days of influence are numbered." Interpreted to apply to our situation in the State of Washington, this means that we must adjust our curriculum to our students, not our students to our curriculum.

If this premise be sound—and I think there is none who will deny it—it gives a rock basis on which to build a structure for undergraduate education that will meet the needs of the youth of our state. These needs may be summarized under four heads; health, economic and vocational guidance, citizenship, and knowledge and appreciation of the things of the spirit. Necessity for brevity prevents me from doing more than summarize reasons for these four points.

I put health first because it is fundamental to success and happiness in life. We may garner the wisdom of the ages, but if we have not health, our lives become a curse to ourselves and oftentimes a menace to those of others. Before graduation, therefore, every student should be taught by skilled instructors how to keep in sound physical condition. He should learn the value of health. He should know not only the worth of exercise, but the right kind of exercise for himself individually; and he should learn enough about diet, foods, and balanced rations to protect himself on the one hand from malnutrition, and on the other from dietary excesses later when he gets into the maelstrom of modern business. Nor should I consider his health education complete until he has been given the scientific facts of sex and sex life that will promise him happiness in marriage. The ignorance of these fundamental matters that has blasted the lives of otherwise highly educated men and women is appalling.

Second, every student should be given economic and vocational guidance. This is of two kinds. One would enable the future citizen to take care of his personal business affairs, no matter what his vocation might be. It would acquaint him with the details of buying real estate, teach him to distinguish between sound investments and spurious speculative schemes, instruct him in the value of life insurance and wills, inform him about loans, mortgages and budgets, and give him the fundamentals of simple banking practice. Too few college and university men know how to manage their personal finances. Too many have had their lives wrecked because of the trust in the promises of visionary stock promoters. And one of the duties this University owes to its graduates is to provide practical business education that will enable them to protect themselves and their families financially.

Vocational guidance in the sense I mean it, does not concern itself alone with training for a specific profession, but with personal guidance of the student into the field where he will be more likely to attain success. Too many of our graduates leave the University merely seeking a job. They

do not know whether they want to teach, sell bonds, or go into manufacturing, or whether they are fitted for any of these vocations. These fields, however, are widely separate. A different type of mind is necessary for success in each. And one of our greatest needs is broadly trained educators who can direct students so that they will not have to spend some of the best years of their lives after leaving the University in floundering around while determining their life work.

I may add that I favor business and professional education. Every male student ought to be able to determine before finishing his junior year the precise vocation into which he is going. The curricula of many of our professional schools, however, need revision, with a view to providing more horizon-widening studies and making Profit and Service their aims, to correspond with the accepted purpose of Scholarship and Service in the colleges of arts and sciences. Men who graduate from the professional schools, if they possess the highest type of mind, find always that they attain their fullest success in business and their greatest happiness in life as much by the horizons of information they have as by the technical training received in specialized fields.

One other interpolation needs to be made under the topic of professional training. This, that the schools on which we should lay our greatest emphasis at the University of Washington are those that fit men for industries or professions in which this state has natural advantages or particular need. Forestry, fisheries, engineering, and education may be cited as illustrations. Too many institutions of learning make the mistake of seeking prestige abroad instead of educating at home.

My third point, citizenship, is obvious enough not to necessitate argument before a thoughtful audience. The majority of our population is insensible to the needs of a conscientious, educated citizenship. Our commonwealth is suffering accordingly. Our laws are violated by those who make them and those responsible for their execution. Many of our highest public officers are chosen by a depressingly small minority of the electorate; and we not only have hundreds of millions of dollars voted for civic and state enterprises, but problems of the greatest importance determined by an interested and often prejudiced few.

What we need in undergraduate education is continuing stress, not alone on forms and methods of government, but on the personal responsibility of the individual for righteous government and direction of the affairs of our state. Not until our students are educated to feel themselves an integral part of government will they have the personal interest in its direction and assume the active leadership that we need from them if our state is to take its rightful place in the affairs of our nation.

My fourth point, knowledge of the things of the spirit, is tuition in what is known in a more or less hazy way as culture, a shibboleth too often used to conceal academic aimlessness. Education is education, and is

worth while, only when it preserves the useful acquisitions of the race. The experiences and the accomplishments of the past are not of value to us except when they can be made useful in the future. A past that has no lessons worth while, has no place in education.

Value does not reside, however, in the mere act of making a living, in eating, drinking, housing ourselves comfortably, and in securing monetary gain. The highest values are in the things of the spirit. We work in order to have leisure; and according as we spend that leisure we have our purest pleasures and our greatest happiness in life, for it is in our leisure hours that we enjoy most fully our spiritual possessions. We need education, therefore, for avocation, for the mental horizons that give breadth of vision and richness of life. . . .

We are not paying sufficient salaries to retain our best men, many of whom, for this reason alone, we have lost in recent years. Yet retention of our strong men is essential to the power of our University; for where great teachers are, great students come and great citizens are graduated. . . .

. . . Letters of the alphabet after a name are meaningless unless followed by the magic letters of efficiency—O. K.

. . . Curriculum makers may use less sophistry in justifying some of their courses of study. It is extremely important to develop a love of learning, a taste for scholarly things, an appreciation of great books, a thirst for knowledge, and a humble attitude toward things of the mind. Great scholars are not always great teachers, but great teachers must first be great scholars. Solid buildings rest upon firm foundations.

—*Journal of Education* (Wisconsin).

THE BRIDGE BUILDER

The bridge builder who has spent a life-time in building bridges is sent for, to put up a new and important communicating bridge.

The bridge builder, having been duly commissioned, draws up plans and specifications for the bridge to be built—he has been doing this all his life, and is widely known for the well-built and durable bridges he has put up before. He knows the meaning, the use, the necessity of every bolt that goes into the structure.

The plans are submitted to the powers-that-be for approval of the specifications and for furnishing of materials, supplies, and help.

In the meantime the bridge builder proceeds to the distant site, to rush forward excavation and building of the piers on which the bridge is to be placed.

Finally materials come forward with action on the specifications showing that many large cuts had been made in what the bridge builder had clearly stated was essential to erect a proper and trustworthy bridge. A third of the bolts, and pieces of steel here and there—the use of which was not clear—were blue-pencilled.

The bridge builder protests but is told that it cannot be helped—that he is to go ahead and accomplish what he can.

Some months later the powers-that-be visit the site to inspect the completed bridge, only to find it still incomplete and barely passable on an improvised road-bed. They return to denounce the bridge builder as incompetent, and unable to meet the ordinary demands of his work, and may even go so far as to declaim on the uselessness of engineers in general.

—CHARLES FULLER BAKER, (Written in 1925)

PRACTICAL DIRECTIONS FOR COFFEE PLANTING¹

PEDRO A. DAVID

Of the Department of Agronomy

(Revised by CHARLES FULLER BAKER)

The receipt, almost daily, by the College of Agriculture of letters from the different provinces of the Philippines and from foreign countries asking for information and advice in regard to the growing of coffee suggested the preparation of this article. The directions here given are written primarily for Filipino growers. They are based upon the experience of practical growers visited outside the College and on 1916-1926 data obtained from the work of the Experiment Station in the College of Agriculture.

The purpose of this publication is to give directions that will assist an ordinary coffee grower in obtaining the "maximum production of quality coffee consistent with the smallest outlay of money and labor". It is impossible to give specific instruction on every point, because conditions and cultivation methods on the different farms vary in detail of practice. The grower, therefore, will use his own judgment in applying these instructions to suit his particular conditions.

In the Philippines, land can be secured: (1) by direct purchase or leasing it from the government, (2) by applying for homestead, (3) by buying it from a private holder, and (4) by renting it from a land owner.

POINTS TO BE CONSIDERED IN SELECTING LAND FOR A COFFEE PLANTATION

Good land. Most of the forest land in the Philippines is well adapted to coffee. A suitable soil should be deep, friable, rich in humus, deep black in color with a good drainage. Sandy, clayey, or calcareous soils should be avoided. Virgin forest land is the best. Coffee will not grow on salty soils.

Elevation. Different varieties of coffee require different elevations. The best elevation depends upon the types of coffee to be grown. The Robusta and Liberica grow from sea level to an altitude of about 900 meters. Arabica grows best at higher levels. Coffee should never be planted near the sea without windbreaks. It has been reported that the strong sea breeze blows off many flowers and consequently the yield is decreased.

¹Experiment Station contribution No. 532. Received for publication January 17, 1928. This article was issued in October, 1926, in mimeograph as College of Agriculture Circular No. 10.

Shelter from wind. Shelter from wind is indispensable, for coffee will not thrive well in a windy place. A sheltered valley is a good location for coffee growing. One's neighbor's experience will help in locating a coffee plantation. Natural barriers are to be preferred.

Shelter from wash. As a general rule a moderately gentle slope on the base of a hill may be selected. Gently undulating table land is the most desirable. Such a lay of land facilitates working and any alluvial deposits remaining on it add to the richness of the soil. A very flat land is undesirable; it retains too much moisture. Also very steep land is objectionable as there will be heavy erosion.

Proximity to river. The coffee plantation must be near a running stream. Watering the young plants in the nursery and preparing the berries for market require much water. But the plantation must not be so close to the banks of the stream as to be flooded during the rainy season.

Climate. A "sub-temperate climate within the tropics" is the most suitable climate for coffee. The climate in Batangas, Bukidnon, Iloilo, and Mountain provinces make these the best regions in the Philippines for planting coffee. The annual rainfall should not be less than 178 cm. It should be supplied as evenly as possible throughout the year. Prolonged droughts are fatal to coffee, but too great a supply of water should be avoided.

VARIETIES OF COMMERCIAL COFFEE

At present there are three groups of commercial coffee grown in the Philippines. These are: (1) Arabica, (2) Robusta, (3) Liberica, with their allied types. These groups vary greatly according to climatic and soil requirements as well as in their resistance to diseases and pests. For this reason it is advisable to describe each group separately.

Arabica. Owing to its superior flavor and aroma, Arabica is the highest priced commercial coffee. It is the only coffee in the Philippines suitable for export. The objection to this variety is that it is highly susceptible to coffee blight, *Hemileia vastatrix* B. et Br. Experiments in the College of Agriculture show that altitude alone cannot render Arabica resistant to *Hemileia*. Arabica cannot be profitably grown at lower elevations. Arabica trees planted at 450 meters above sea level were badly attacked by the rust. This variety may be planted only at high altitudes. It should not be planted in places where the rainy season coincides with the plant's flowering time. This type flowers from December to January. The harvesting of the berries comes during November, January, February, and March. Arabica requires a rich, deep, and friable soil. Under ordinary conditions, it gives a yield of about 250 to 400 kilograms of coffee to the hectare of 1600 trees, planted 2.5 by 2.5 meters.

Robusta. This group has the poorest flavor of all the coffees tried in the College of Agriculture. It thrives at an altitude between 200 to 600 meters above sea level. It may be grown at lower levels, but not profitably. This

variety requires soil that is rich and friable and has an abundance of organic matter. It is very particular about soil. An annual rainfall of 2 to 2.5 meters of equal distribution throughout the year is required. Robusta is very sensitive to heat. If the land becomes dry during the flowering season a great part of the crop is lost. This variety flowers from December to March and the harvesting of the berries comes during November, December, January, February, March, and April. The berries of Robusta vary greatly in size. They ripen more slowly at high altitudes. Many branches dry out after the harvesting season. The trees yield three years from the time they are transplanted in the field. Under favorable conditions Robusta gives a yield of from 700 to 900 kilograms of coffee to the hectare of 1,111 trees, planted 3 by 3 meters. Authorities on coffee call attention to the fact that Robusta gives excellent satisfaction as a catch crop under young rubber trees. The coffee trees are cut down before the rubber trees begin producing. Many coconut planters in Laguna plant Robusta under old coconut trees.

Liberica. The Liberica coffees, including Excelsa, can be planted from sea level to 300 meters above sea level. Excelsa can be grown at very much higher altitudes. Liberian types are quite drought resistant and produce vigorous plants. They resist the attacks of nematodes and *Hemileia vastatrix* B. et Br. They can be grown where the dry season extends to several months of the year and can grow on heavy soils. They begin to yield five years from the date of transplanting in the field. The flowering season takes place from March to July and harvesting of the berries comes during February, March, and April. Better production can be expected with 1.2 meters of evenly distributed annual rainfall. The yields of Liberian and Excelsa varieties vary from 400 to 500 kilograms of coffee to the hectare of 500 trees, planted 4 by 5 meters. The coffee planters in Batangas and Laguna prefer Excelsa to Robusta because of its wide adaptability and greater resistance to drought, diseases, and pests. Liberian coffees require less care than either Arabica or Robusta.

VARIETY TO PLANT

Every coffee planter should plant only the variety that produces the best quality of berry in the region where his plantation is. The question as to which type of coffee is adapted to a locality requires much attention. In establishing a coffee plantation in a place where coffee is already growing, one should study the local varieties grown and try to find the best and most profitable type. Examine the varieties of coffee growing in the neighboring towns and barrios where the conditions of soil, climate, altitudes, etc. are similar to the proposed plantation. Only one variety of coffee should be planted. Different varieties when grown in one plantation involve much work, for each type of the coffee mentioned above requires different treatment in the field and in preparing the product for the market. In very large

plantations covering different altitudes, more than one variety may be planted.

SEED SELECTION AND PREPARATION OF SEEDS FOR PLANTING

Seeds for planting should be picked at the end of the harvesting season and only from the best yielders and healthiest trees. The berries should be well ripened and large and free from any signs of disease. Plant only fresh and selected seeds. All pea-bean shaped beans should be discarded. It is advisable to pulp the seeds with a hand-pulper. The slimy mass covering the beans can be removed by rubbing them with lime or fine sand and washing the seeds thoroughly with water. All beans that float on the water during the washing process should be discarded. The washed seeds can be dried in the shade. The seeds selected for planting should not be kept longer than five months or they will lose their vitality.

For several reasons it is not advisable to buy seed for commercial planting from coffee dealers in other countries. Commercial coffee is usually dried artificially at a high temperature. In most cases the embryos are killed in the fermenting process. The value of imported seeds as stock is not reliable. They are often harvested from unselected trees in the plantation and they may carry disease. The plants from these seeds have to be acclimatized. Seeds for planting should be purchased only from reliable sources.

SEED BEDS AND NURSERY

Location. A cool, sheltered and a well drained location should be selected for a seed bed. The soil should be virgin but not richer than that of the plantation where the seedlings will be permanently planted. Seedlings nursed in a very rich seed bed suffer much when transplanted to a poorer soil. The seed bed should be near a good supply of water and close to the planter's house. The nursery requires the planter's personal attention. In large coffee estates, nurseries can be located in different parts of the plantation, say one nursery for every five-hectare plantation. When coffee is not planted on a large scale, seeds may be grown in seed boxes. Kerosene boxes cut lengthwise into halves make good germinating boxes. The germinating soil should contain equal proportions of well rotted leaf mold, fine sand and ordinary garden soil. Small holes should be made in the bottom of the boxes and a small amount of fine gravel put in for drainage. Then add the soil mixture of well rotted leaf mold, fine sand, and garden soil. After the seed is planted the boxes should be kept above the ground on a bamboo or wooden platform. In large scale planting, the seed bed method is more practical than the seed boxes.

Preparation. The seed beds should be prepared with the utmost care. Cut all brush and grass, then dig up the roots and pile them upon the beds, where they may be left until dry enough to burn. Some planters do not burn the trash but remove it from the beds. After cleaning, the beds are

dug up with a spade to a depth of about 30 centimeters. They may also be plowed several times. After spading the beds, the addition of a good supply of well decayed manure or compost is often advisable. After the soil is thoroughly prepared, fertilized if need be, beds of one meter wide and as long as desired, leaving a path 50 centimeters wide between them, are made. Long beds are preferable. The soil in the beds should be well pulverized by repeatedly working it over with a spading fork or hoe and the surface should be made smooth with a rake. The beds are often raised slightly above the general surface of the ground for drainage. After the beds are well worked out and smoothed, divide them with a planting line crosswise into rows about 15 centimeters apart. Make a groove four to five centimeters deep along the line.

Planting the seed. Plant the unhulled seeds about 2 to 2.5 centimeters apart in the grooves. Cover them with finely pulverized soil. Some planters do not make grooves on the beds. They just place the seeds on the smooth surface of the bed, about 10 centimeters apart and then press them in lightly with a finger to a depth of 3 to 5 centimeters. After the seeds are planted, the beds may be covered with rice straw or cogon grass (*Imperata cylindrica* var *Koenigii* (Retz) Benth) to prevent the rain from uncovering the seeds and to keep the earth moist and free from weeds. Thorough watering should follow planting. Thereafter, watering should be done late in the afternoon and as often as necessary. The seeds will germinate in from four to eight weeks.

Shading the beds. To protect the seed beds from the intense heat of the sun, hard rain, and rapid evaporation of moisture, they should be provided with either natural or artificial shade. The simplest method of shading the seed beds is to construct a bamboo framework (*balag*) resting upon bamboo or wooden posts, high enough to permit the nursery man to work freely under the shed. On the top of the framework lay palm leaves or cogon grass, allowing a little sunlight to fall on to the beds. The shading material should be tied securely to the framework to prevent it from being blown off by the wind. Some farmers do not use palm leaves or cogon grass for shading the beds, but, instead, plant some climbing plants, such as upo, (*Lagenaria leucantha* (Duch.) Rusby), patola (*Luffa acutangula* (Linn.) Roxb.) batao (*Dolichos lablab* Linn.) and the like so they will cover the framework. The climbing plants should be planted early enough so that the shade will be ready by the time the coffee seeds are planted. The shade should not be too dense. When the seedlings have developed two or four leaves they are ready for transplanting in the nursery beds.

Planting in the nursery beds. Some coffee planters transplant the seedlings from the seed beds to a nursery bed. This operation checks the growth of the seedlings. It hardens the young wood and makes the young plants better able to resist the attack of insects and unfavorable weather. When the nursery beds are used, the young seedlings are carefully trans-

planted in rows 20 to 30 centimeters apart using a sharpened bamboo stick or trowel to dig them up and to plant them. The transplanting should be done during cloudy weather or late in the afternoon. In transplanting, care should be taken not to double up the tap roots. The seedlings in the nursery beds should be less shaded than in the seed beds. The beds must be kept well weeded at all times and watered as often as necessary. The seedlings should be left in the nursery beds until they are strong enough to withstand conditions in the plantation.

Some farmers make use of the young plants which spring up around the old coffee trees in the plantation for nursery seedlings. These seedlings are from ripe berries which have been shaken off by the wind and from over-ripe ones which have fallen between pickings. Such plants require much attention before they can be planted out in the field. Their merit as stock is uncertain.

Transplanting to the field. When the seedlings have attained a height of 35 to 45 centimeters or have six or seven pairs of leaves they are ready for transplanting to the permanent plantation. Some planters prefer to transplant large seedlings, after they are about eighteen months old. In the College of Agriculture, it was found that the younger the seedlings the less they suffer in transplanting. Selection of the seedlings should be rigid during the process of transplanting. Only the most vigorous seedlings should be used for planting in the field. Large seedlings to be shipped to some distance, should be dug up with a ball of earth with their roots. The balled seedlings can then be packed in a box or banana sheath. Young seedlings when transplanted are just pulled up without soil and then packed in bunches. Sometimes old seedlings when transported to some distance are cut off about 30 centimeters above the ground. The remaining leaves are cut to about one-half their size, after the seedlings are transplanted in the field. Care must be taken in transplanting not to injure the roots. The best time for transplanting from the nursery to the permanent plantation is the rainy season.

PREPARATION OF THE LAND

In establishing and running a coffee plantation, the new coffee grower will do well to follow the local methods of preparing and cultivating land. These local methods followed by the common farmers may have certain faults from the viewpoint of a trained coffee grower, but corrections can be made only after long and careful observations. The utmost care should be taken in the preparation of the land. Errors made in this work will be very difficult to correct and will mean a great loss of time, money, and labor.

The first step in the preparation of the land is the clearing of the forest. When timber land is to be used for the plantation, some farmers clear it by cutting down all undergrowth and felling all the trees and then burning

over the area. This system of burning the clearings can not be recommended where there is a fear of loss of humus.

Other planters in clearing the forest leave the larger trees standing to furnish immediate shade for the young coffee plants. On hilly land the trees at the top of the plantation are left to act as windbreaks and to prevent washing. Palm trees, such as buri (*Corypha elata* Roxb.), coconut (*Cocos nucifera* Linn.), or caong (*Arenga pinnata* Wurmbr.) Merr.) should not be left standing in the plantation among the coffee trees as their falling leaves may cause great damage. Many planters object to leaving large trees for immediate shade in the plantation; they claim (a) not all trees in the forest are suitable for shade trees, (b) the shade trees will not be at equal distances apart among the coffee plants, and (c) the kind of shade needed by the coffee plants is frequently not the kind of shade afforded by the forest trees left uncut.

Another method employed in clearing forest land is to cut down the trees, then lop them before they get seasoned and tough. The wood, leaves, and litter are left on the ground to decay. This practice will preserve the humus, but it will take two to three or more years for the cut trees and branches to decay.

In preparing the soil for the new plantation under the intensive cultivation methods, the forest is cut down as in the *caiñgin* method of clearing a field and then the wood, branches, leaves, and litter are burned during summer. The whole place is then planted to upland rice. The cuttings for shade trees are planted at the same time as rice. Madre de cacao (*Gliricidia sepium* (Jacq.) Steud.) cuttings about one meter in length when planted six meters apart will make satisfactory temporary shade. The best time for planting these is from May to June. After the first two crops of rice are harvested, the madre de cacao will be ready to afford the necessary shade for coffee seedlings. In the coffee districts of Lipa, Batangas, after the field is prepared, the madre de cacao seeds are drilled in or planted like corn in rows about 1.25 meters apart.

Cogon land may be used for a coffee plantation. It should be plowed several times and then planted to some kind of heavy growth legumes. The legumes must be planted one year before the coffee is to be set in the field. Never plant coffee as long as there is cogon grass on the land. The legumes must be plowed under. This will improve the mechanical texture of the soil. Then plant the madre de cacao seeds in rows. Constant weeding is necessary. When the madre de cacao seedlings are large enough to furnish the shade, the coffee seedlings should be transplanted.

Where there are *aparceros* (tenants) the land may be leased to them for a certain length of time. If the terms are satisfactory to the *aparceros*, they will clear and farm the land in a most satisfactory manner. Generally, they plant rice (*Oryza sativa* Linn.), corn (*Zea mays* Linn.), root crops, banana (*Musa sapientum* Linn.), mungo (*Phaseolus aureus* Roxb.) and

other legumes between the coffee trees. As soon as the coffee trees begin to bear, the contract with the *aparceros* may be renewed. The conditions of the contract depend to a great extent on the locality. Some of the plantations in the College of Agriculture are worked by the *aparcero* system.

DISTANCING, LINING, HOLING, AND PLANTING

Distance of planting. The distance of planting depends upon: (a) variety planted; (b) richness of soil; and (c) climate. In exposed plantations, close planting is advisable. Where the soil is rich and the climate is warm and humid, wider planting is good. In the College of Agriculture Experiment Station Farm, the distance of planting and the number of plants contained in a hectare are as follows:

<i>Groups</i>	<i>Distance</i>	<i>Number of trees</i>
Arabica coffee.....	2.5×2.5 meters.....	1600
Robusta coffee.....	3.0×3.0 “	1111
Liberica coffee.....	4.0×5.0 “	500

The planting was done in squares. It has been the experience with the College of Agriculture plantations that trees planted too close together grow slender and are more attacked by cryptogamous diseases than when farther apart. Also, when light and air are not sufficient the crop is decreased. Mr. Leon Katigbak, a coffee grower in Lipa, Batangas, recommends planting Robusta at 3.75 by 3.75 meters.

Lining. Coffee plantations can be lined by using a rope or planting line to which pieces of white cloth are securely tied at the distances apart at which one desires to set the coffee plants. The planting line, handled by two persons, one at each end, should be stretched across the plantation and tied at each end to a pole. The poles must be at least three meters high. After the line is stretched, the two men drive pegs at each rag on the planting line. A good laborer with an ordinary bolo can prepare about 400 pegs a day. When a row is pegged, the men at the ends of the planting line measure off the distance to the next row with the poles and move the line over. The process is repeated until the whole plantation is pegged. In many plantations, pegs are set by measuring off the distance of planting with a stick cut the right length. Care must be taken in this method to set the pegs in straight lines.

Holing. With a spade dig a hole around each peg. The size of the holes depends upon the nature of the soil. In stiff and poor land large holes are preferred. In good light ground, holes of 45 centimeters cube are sufficient. One man can dig from 40 to 50 holes of 60 centimeters cube in a day. The soil taken from the holes is piled on one side of the hole and should be left until the planting time.

Planting. Planting must be done at the beginning of the rainy season. Never attempt to plant coffee trees during the dry weather. The best

time for most localities in the Philippines has been found to be in May and June. In planting, first fill the hole partially with well rotted leaves or mold which can be gathered near the hole. This light filling is essential and must be done just before the coffee seedling is set in the center of the hole. After the seedling is placed in position, fill up the hole with the soil that was taken from it and carefully press it in around the young plant. Never leave a hollow place around the seedling where water can accumulate. If the seedlings are nursed in bamboo pots, wet the soil in each pot before transplanting. When ready for planting, each pot is split by a sharp blow of a bolo on one side. The pot will separate and the seedling with its roots undisturbed can be at once set in the center of the hole which has been partially filled with well rotted leaves and molds. In planting, care must be taken not to injure the roots. The tap root should not be allowed to become bent, twisted or broken when the seedling is set in the hole. It should go down straight with the stem. If the roots are much injured in planting, it is well to take off some of the lower leaves. The remaining leaves can be reduced to about one-half their size, depending upon the circumstances. After the seedling is planted, the soil should be pressed down firmly around the stem. Sometimes staking the seedlings to prevent too much shaking is done. If dry weather follows the transplanting, watering the young plants is advisable. When the shade is not sufficient at the time the coffee seedlings are planted, temporary shelter of some kind must be provided. Some planters use palm leaves for temporary shade. The leaves are driven firmly into the ground in a slanting position close to the seedlings. When vacancies occur in the plantation, they should be filled in as soon as possible from the seedlings left in the nursery. Seedlings used for replanting must be well-grown and at the same age as the first seedlings planted in the plantation.

SHADE

The question of shade in coffee culture in the Philippines should be given the most careful attention by the planter. The income from a coffee plantation is to a greater or less degree determined by the presence or absence of the shade trees. The shade trees for coffee are beneficial in many respects, provided they are of the right kind and properly situated in the plantation. They conserve the soil moisture, keep down the growth of weeds and grass, prevent erosion, and protect the coffee from the violence of strong wind. Wind is very detrimental to coffee during the blooming period. It is said that coffee trees under shade last longer. Other things being equal, the coffee trees under the right kind of shade yield better crops.

In the Philippines, not all trees are suitable for shade trees. Only quick growers, such as leguminous trees, should be used for shade. The leguminous trees keep the soil cool and enrich it with nitrogen and humus by means of their root nodules and fallen leaves and flowers. In many

places kakauate, or madre de cacao, ipilpil, or Santa Elena (*Leucaena glauca* (Linn.) Benth), and anii (*Erythrina fusca* Lour.) have been found to be the best shade trees. The easiest way to plant shade trees is to grow them first in the nursery. Kakauate and ipilpil when grown from seeds should be planted in nursery beds the same as the coffee seeds. The best time to do this is at the beginning of the rainy season. Some planters use the seedlings of ipil-pil which spring up around old ipilpil trees. Many planters in Batangas plant madre de cacao seeds just after the land is cleared. The seeds are planted like corn, dropping four to six seeds to the hill at one by one meter. The planting may be done at the same time the rice is planted. At the end of the second year, rice planting is discontinued and the coffee seedlings are planted when the madre de cacao trees are large enough to afford shade. Cuttings of ipilpil and madre de cacao are sometimes planted instead of the seeds. The cuttings can be planted in holes made with crowbars; the soil should be firmed around them very carefully. They should be set in the ground so as not to be easily pulled out.

The density of shade required can be determined only by actual and careful field observations of the local plantations. The shade varies according to locality and elevation. Shade requirement decreases as the altitude increases. It must be remembered that thick shade encourages the coffee trees to grow too tall. Too much shade, even with leguminous trees, should be avoided. Excessive moisture because of thick shade decreases the crop and the coffee trees are exposed to the attack of fungous diseases. It has been advised by many coffee planters that shade trees should be planted rather closely and the unnecessary branches or trees gradually cut out.

The shade trees may be planted according to the following diagram:

(A) S c c S c c S c c S c c S c c S c
 S c c S c c S c c S c c S c c S c
 S c c S c c S c c S c c S c c S c
 S c c S c c S c c S c c S c c S c

S=shade trees planted at 6 by 6 meters.

c=coffee trees planted at 3 by 3 meters.

The shade trees may be set alternately at regular distances from the coffee trees, and later every alternate tree be cut out as indicated in the following diagram:

(B) S \$ S \$ S \$ S \$ S \$ S
 c c c c c c c c c c c
 S S S S S S S S S S S
 c c c c c c c c c c c
 S \$ S \$ S \$ S \$ S \$ S
 c c c c c c c c c c c

S=shade trees; c=coffee trees

\$=shade trees cut out.

Mr. Leon Katigbak of Lipa, Batangas, recommended the following scheme:

(C)	X	X	X	X	X	X	X	X	X	X	X
	c			c			c			c	
	X	X	X	X	X	X	X	X	X	X	X
	X	X	P	X	X	P	X	X	P	X	X
	X	X	X	X	X	X	X	X	X	X	X
	c			c			c			c	
	X	X	X	X	X	X	X	X	X	X	X

X=madre de cacao seeds planted 1.25 by 1.25 meters as temporary shade; c=coffee trees (*Robusta*); P=madre de cacao trees to be left as permanent shade; the distances of the coffee and the madre de cacao trees being 3.75 by 3.75 meters.

Temporary shade is often necessary in order to protect the young coffee plants. In many coffee plantations either castor oil beans (*Ricinus communis* Linn.), papaya (*Carica papaya* Linn.), cassava (*Manihot utilisima* Phol), banana or pigeon pea (*Cajanus cajan* (Linn.) Millsp.) is planted alternately with the coffee trees. The last named of these temporary shade plants enriches the soil. It adds large quantities of leaves rich in nitrogen and its roots penetrate well into the soil, thus improving it. The temporary shade must be gradually thinned out or cut down as soon as the coffee trees are well established and finally only the permanent shade trees should remain. Another important consideration in connection with *Cajanus* is that it yields a valuable food crop while in use as temporary shade.

WEEDING

The coffee plantation should be kept weeded clean. Before the weeds have time to take root, weeding should be done once a month or oftener if necessary. It is cheaper and more profitable to keep the plantation clean from the beginning. Experienced planters recommend hand weeding on light soils and sloping locations. The cut weeds are either buried or left on the plantation. Hand weeding is beneficial on heavy and compact clay soils, level plantations, and in a damp, cool climate. The best time for this operation is during the dry weather. Hoeing must be done at regular intervals whether weeds are present or not. Care must be taken in hoeing not to injure the fine roots of the coffee trees and to cover them well. Heaping the soil around the trees is not good; it encourages more surface roots. Hoeing should be done from the middle of the row toward the trees. It is not advisable to dig too close to coffee trees. The laborers should be instructed not to wound the lower part of the stem of the coffee trees, as wounds encourage the growth of unnecessary sprouts which should be taken off as soon as noticed. Weeds should never be allowed to run to seed.

Cultivation. During the first year, the spaces between the rows of the coffee trees may be cultivated with animal cultivators. This cultivation must be followed by hand hoeing. In places where the use of the animal cultivator is impracticable, hand weeding should be resorted to. All cut weeds should be left in the field to serve as mulch and green-crop manure. As soon as the coffee and shade trees begin to shade the land, cultivation becomes less expensive. The most satisfactory method of controlling the weeds in a coffee plantation is by planting some kind of cover crop that will last for more than six months.

The most advantageous time to cultivate coffee estates is at the beginning of the dry season. Mulching the coffee trees through the dry season with vegetable waste of all kinds is very practical. Even cut cogon or rice straw is good if other materials are not available. This mulch not only enriches the soil around the coffee trees but it prevents rapid evaporation. It should be remembered, however, that an excess of water is harmful, especially during the fruiting season. Irrigation on coffee estates is not practiced for it has been found that irrigated coffees have poor aroma and quality.

PRUNING

In order to concentrate the energy of the coffee trees on the production of fruit, to keep them in good shape, and to facilitate the picking of the berries, coffee trees must be pruned properly. Unpruned trees grow too high and bear comparatively small crops.

To prune well requires careful study and experience. The first pruning is to top the trees as soon as they attain the height of 1.5 to 2 meters, according to local conditions and desire of the farmer. Topping is done by pinching off between the finger and thumb the top soft wood of the bush to a height that will permit the berries to be picked without climbing on the coffee trees. As a result of topping, a number of vertical suckers from under the primary branches and along the stem will appear. These should be carefully removed while young, by cutting them off with a sharp knife but without injuring the bark of the tree. Later on, secondary branches will spring up from the primary branches. Remove all the secondary branches appearing within 15 centimeters of the main stem so as to let in air and sunlight freely. Use a very sharp pocket knife for this purpose. All water sprouts and dead branches should be carefully removed. In case a number of branches grow in different directions from each node of the primary branches, remove every alternate secondary branch. Topping and pruning must be done during the first and second years. All young shoots arising from injuries to the trees near the ground should be cut off early. All epiphytic plants on the coffee trees should be removed. If practicable, pruning should be done twice before cropping. It should commence after harvesting the berries and be finished before the blossoms come out.

Neglected trees can be gradually improved by sawing off all worthless branches and opening up the center of the tree in the first year. Cutting should be done close to the main stalk. Then thin out one-half of the remaining wood in the second year. New shoots soon come out. These must be cultivated to form a new tree. The coffee trees should not be allowed to have more than two or three main stems. All additional suckers at the base of the tree should be removed promptly as they appear.

Small neglected plantings in the College of Agriculture were renovated by cutting off the main stems of the trees about 30 centimeters above the ground, and allowing two to three suckers to form a new tree. Many new sprouts appeared from the stump, but all except the required number were removed as they attained the height of 30 centimeters. On very badly neglected plantings, the trees were cut off near the ground and the whole field plowed. The plowing was done close to each side of the stumps and new shoots appeared in a short time. Very old plants were replanted with new seedlings from the nursery.

CATCH CROPS

Many coffee planters do not approve of the planting of catch crops with the coffee trees while young. In the coffee plantations at the College of Agriculture catch cropping was found beneficial to the College as well as to the coffee trees. The unoccupied land was made to yield some returns for the College. The coffee trees were benefited by the tillage required by the catch crops and the shade afforded by them was found beneficial to the young coffee plants. Tobacco (*Nicotiana tabacum* Linn.), sweet potatoes (*Ipomoea batatas* Linn. Poir.), and corn were found to yield good returns as catch crops, but they do not afford shade to the coffee plants and were found to be rather exhausting to the soil.

A very desirable catch crop for coffee should give good returns to the farmer, not be too heavy for the soil, bear early, and leave the plantation clean when taken from it. It must not be a climbing vine. The farmer can plant either corn, rice, sweet potatoes, tobacco or peanut (*Arachis hypogaea* Linn.) or legumes as catch crops. The kind of catch crop to be planted depends upon the local market requirements and the desire of the farmer. The planting of catch crops may be done while the coffee trees are young, and must be discontinued as soon as the shade and coffee trees begin to entirely occupy the ground.

HARVESTING

Harvesting of the berries of Robusta and Arabica types is done from November to April, while the crops of the Liberian type come in February, March, and April. Arabian coffee must be gathered when the berries become red. Picking must not be delayed for the berries do not hang on well on the branches. Liberian berries do not fall but remain on the trees.

The crop does not ripen at the same time. Two or three pickings are necessary. Whenever practicable, the berries of Arabica and Liberian types should be picked as they become ripe. Care must be taken to pick the berries one by one and never strip off the whole cluster. Undeveloped blossoms should not be injured. When some unripe berries are gathered, they spoil the quality of the coffee. The ground under the trees should be kept clean when gathering the berries. Spreading an old mat under the tree and then shaking it so that the berries will drop on the mat is not a good practice for both unripe and ripe berries will drop. When the trees are high the pickers can bend the branches if careful not to break them. In some places, the farmers allow the berries to remain on the tree until they are dried and then gather them at their leisure. This practice cannot be recommended. If the berries are allowed to get over-ripe on the trees, they are likely to burst and drop when it rains. This will result in the loss of the crop.

METHODS OF PREPARING THE BERRIES FOR MARKET

There are two methods of preparing the berries of coffee for market. The first method is to spread the freshly picked berries in a thin layer on an open dry cement floor or on a wooden floor or in *bilaos*. During the drying process, to secure even and thorough drying, the berries should be stirred with wooden rakes or with the hands several times a day. The berries are raked into heaps and then covered with mats or other similar material in the evening or in case of rain. The berries must be kept spread out during the day and not allowed to heat. The sun-drying process lasts about fifteen days for Robusta and forty days for Liberica in clear warm weather. Incomplete sun-drying will result in making the hulling of the berries difficult. The beans are subject to attack by molds when not properly dried. After complete drying, the dried husk, pulp, slime, hull, and part of the silver skin can be removed by pounding the berries with a pestle in a native mortar. Some farmers use a hand rice-hulling machine for this process.

The second method can be employed where there is a large harvest and a good supply of water. It requires rather a large investment in machinery and equipment. The freshly picked berries are first wet and classified by dropping them into a tank filled with water. All the heavier berries remain at the bottom of the tank and the lighter ones float; these should be discarded. All the berries that remain at the bottom of the tank are ready for pulping. Soaking the berries for a few hours is essential, as the pulp must be soft before it can be removed by the pulper. After soaking, the berries are run through a "disc-pulper" machine which separates the beans from the pulp. Pulping the berries must be done soon after they are washed. The ripe berries pulp more easily if it is done immediately after they are picked. The ordinary machines sold by John Gordon of London are good. Some farmers in Lipa, Batangas, have devised home-made wooden pulpers.

The pulped berries which come from the pulper are covered with a sticky mucilaginous substance, so they are put into a fermenting tank filled with water and washed very thoroughly. The water is changed as often as necessary. After washing, the berries are fermented in a vat filled with water until the sugary substances come off easily. The mass should be stirred from time to time. All light pulp which floats on the water should be removed. Care must be taken not to over-ferment the berries, as this will spoil the quality of the coffee. When the berries are cleaned of the mucilaginous matter they are ready for final washing. The pulped berries can also be fermented in heaps for twelve to sixteen hours without water, by placing them in a perforated tank and turning them over occasionally. After this process the berries are carefully washed. See that all the berries are free from mucilaginous substance. All light berries and other matter which floats during washing should be thrown out. After the washing process the berries are drained thoroughly by placing them in draining boxes or sieves. They are then spread in a thin layer on a drying floor or on an ordinary mat to be sun-dried. Sun-drying must be done immediately after washing. It must be uniform and not too rapid. The berries must be turned over occasionally on the drying floor. The beans are taken in each day in the mat and allowed to continue to dry under cover. Under ordinary conditions, four days sun-drying is sufficient. The beans must never be heated artificially in drying. When the parchment is quite brittle, the coffee can be stored. Coffee in this condition can be kept without harm in a *bodega* (warehouse). The beans can be run through a polishing machine. The broken parchment and dust from the coffee bean can be separated by means of a rice winnowing mill or by using *bilaos* (large shallow bamboo baskets).

COFFEE DISEASES AND PESTS

In the Philippines some of the chief enemies of coffee trees are the fungi, parasitic plants, stem borers, *cercospora*, white bark mold, birds, monkeys, white ants, and cattle. The fungi and insects give the most trouble in the College of Agriculture cultures and in most private plantations.

The most destructive disease is the coffee blight, or rust which is caused by *Hemilea vastatrix* B. et Br. This was the disease that wiped out the coffee industry in Lipa, Batangas. This disease is characterized by the presence of yellow powdery spots containing spores found on either the lower or upper side of the leaves. It causes the leaves to fall. It is most severe during the rainy season. The rust can be controlled by spraying with standard Bordeaux mixture, which costs about twenty centavos a tree for a year's spraying. Standard Bordeaux mixture is prepared as follows: Dissolve 1.8 kilograms of copper sulfate in 95 liters of hot water. Slake 1.8 kilograms of stone lime in water and dilute it to exactly 95 liters. Then mix the two solutions very thoroughly. Spraying must be done before the

coffee trees show any signs of infection. New plantations in the Philippines should be planted only with resistant varieties of Excelsa, Liberica, or Robusta.

Among the insect pests, the coffee borers are the most serious. These bore holes in the wood and thus enter the trunk and branches of the trees. They lay their eggs and the larvae sap the life of the coffee trees. As a result of this, the affected trees wilt and finally die.

Scale insects excrete honey-dew and cause black mold to develop on the leaves.

Beetles, crickets, and caterpillars attack coffee leaves.

Monkeys and cattle damage the coffee trees. The cattle eat the tender leaves of the coffee and the monkeys devour the ripe berries. These animals can be scared off or driven away from the plantation by keeping two or three good watch dogs around the place.

A semi-parasitic plant called dapo kahoi (*Loranthus philippensis* Cham. and Schlecht.) is likely to grow on the stems and branches of the coffee trees. This plant attaches itself to its host by suckers or haustoria which are modified adventitious roots. It should be removed at once.

The great factors in preventing the spread and destructiveness of coffee diseases and pests are clean and proper culture, sanitation, pruning, and spraying. Successful control of diseases and pests depends upon very close attention to detail and upon constant care. Neglect commonly means failure in coffee production. Care, thoroughness, and neatness bring their just reward to farmers in modern plantation work in controlling disease and pests of coffee trees most effectively, as has been abundantly shown by progress secured in the College of Agriculture, through a long series of actual field experiments.

ESTIMATE OF OPENING ONE HECTARE PLANTATION

The following estimate by Mr. Agapito Templo, a practical farmer in Mataas-na-cahoy, Lipa, Batangas, on the cost of opening one hectare of land with coffee may be of use to beginners in coffee growing. In this estimate the land is owned by the planter: it may be either forest or open.

If the land is forest, cut down only the large trees. In case the land is open, plant madre de cacao seeds in order to loosen the soil and at the same time to provide temporary shade for the coffee seedlings.

The following are the expenses involved:

<i>First Year</i>	
1. Madre de cacao seeds at 6 seeds to the hill.....	P 4.00
2. Planting madre de cacao seeds, 1 by 1.5 meters.....	5.00
3. Clearing, lining, and staking.....	15.00
4. Holing (1,110 holes).....	5.00
5. Planting coffee seedlings.....	5.00
6. Weeding after three months.....	10.00
7. Tools (hoes, rakes, trowels).....	12.00
8. House.....	20.00
9. Nursery work.....	20.00
Total.....	P96.00

Second Year

1. Weeding, twice a year.....	P20.00
2. Replanting.....	5.00
3. Topping and suckering of coffee trees, and thinning out the madre de cacao shade.....	15.00
Total.....	P40.00

Third Year

1. Weeding, twice a year.....	P20.00
2. Replanting and removing suckers.....	5.00
3. Trimming of shade trees.....	15.00
Total.....	P40.00

Fourth Year

1. Weeding twice a year.....	P20.00
2. Topping and pruning.....	5.00
3. Pruning shade trees.....	5.00
4. Ladder and bench.....	10.00
5. Drying floor (cement).....	100.00
6. Pulper and storehouse.....	50.00
Total.....	P190.00

Fifth Year

1. Weeding, twice a year.....	P20.00
2. Pruning coffee trees.....	5.00
3. Pruning shade trees.....	5.00
4. Repair of tools and house.....	10.00
Total.....	P40.00

Sixth Year

1. Weeding, twice a year.....	P20.00
2. Pruning coffee trees.....	5.00
3. Pruning shade trees.....	5.00
4. Repair of tools, and house.....	10.00
Total.....	P 40.00

Seventh Year

1. Weeding, twice a year.....	P 20.00
2. Pruning and suckering coffee trees.....	5.00
3. Repair of tools and house.....	5.00
4. Pruning shade trees.....	2.00
Total.....	P32.00

SUMMARY

	<i>Expenses</i>	<i>Estimated harvest from one hectare</i>
First year.....	P 96.00	None
Second year.....	40.00	None
Third year.....	40.00	P 40.00
Fourth year.....	190.00	100.00
Fifth year.....	40.00	150.00
Sixth year.....	40.00	200.00
Seventh year.....	32.00	350.00
Total.....	P478.00	P840.00

NOTES:

"One hectare plantation will not keep a tenant busy throughout the year so that he must be employed in other work. His main work is to inspect the plantation once in a while, his wages therefore is not included in the above items. Usually, when harvest time comes, he gets ten per cent of the total produce.

"The length of time required before the crop comes to bearing depends upon the soil condition, and the variety of coffee planted. Robusta produced fruits after three years, Excelsa and Liberica after four years. The objection to Robusta is that it is very sensitive to heat especially if the flowering season coincides with the dry season; if the land gets dry during the flowering season practically fifty per cent of the crop is lost. Liberica and Excelsa on the other hand can resist drought lasting several months.

"Bending the branches outward while the trees are young encourages the production of more branches from the main stem. Liberica and Excelsa may be pruned, but if the branches are spread outward it is hardly necessary.

"In some cases one-fifth of the produce when harvested goes to the harvesters or pickers. Sometimes the pickers are paid five centavos for every kilogram of Robusta and Excelsa gathered and two centavos for every kilogram of Liberica.

"A pulping machine is indispensable for the preparation of the Liberica berries, because it will take about forty days to dry the berries under the sun. It takes about fifteen days to dry Robusta berries under the sun.

"For polishing the beans, the rice mill (Paris Engelbert) is ideal. The ordinary native mill is also good. Silverskin adhering to the beans should be thoroughly removed for it gives a very undesirable taste to the coffee. This is especially true with the Liberian type."

STUDIES ON THE CORRELATION BETWEEN THE SEED AND STRAW PRODUCTION OF SOME FIELD LEGUMES ¹

P. A. RODRIGO

Of the Department of Agronomy

The study of correlation of characters in crops is a matter of common interest to the farmer and the plant breeder. It is an interesting study, especially with annual farm crops, and is generally fruitful of practical results for the amelioration of these crops.

The cowpea (*Vigna sinensis*), mungo (*Phaseolus aureus*), soybean (*Glycine max*), peanut (*Arachis hypogaea*), and *Phaseolus calcaratus* are the subject of the present study on correlation. These are crops of which both the seed and straw are highly valued, the seed as a source of nutritive food for man and the straw as a palatable feed for live stock. With the exception of peanut, all these legumes are good cover and green manure crops.

In a crop where the seed and the straw are highly valued, the aim of the farmer is to grow a variety or strain that produces plenty of seed and at the same time has heavy tonnage of straw. As it can be grown for dual purposes, such a variety or strain would certainly be much more economical to handle than when grown for only one purpose. Any study therefore on the relationship between the seed and straw producing power of some of the important Philippine legumes should prove valuable to both the farmer and the plant breeder.

So far as the writer knows, the cowpea, mungo, soybean, and peanut have not been chosen as subject for detailed study on correlation. For while Spillman (1913) found correlations between the production of certain seedcoat colors and the occurrence of an anthocyan in the flowers, these characters, as a whole, are of no immediate practical importance to the farmer. Williams and Park (1917), working on more important characters report that in soybean the highest seed yielders had a comparatively low proportion of straw to seed.

MATERIAL AND METHODS

The data presented in this paper were obtained from the 1926-1927 and the 1927-1928 dry season legume cultures of the Division of Farm Crops of the Agronomy Department. All the plants used in this study were obtained from variety test cultures. The data relate exclusively to the

¹Experiment Station contribution No. 533. Part of paper was read before the Los Baños Biological Club, September 1, 1927. Received for publication, March 28, 1928.

yield measurements of the seed or pod and straw of seven varieties of cowpea, two varieties of soybean, four varieties of mungo, including one variety of *Phaseolus calcaratus*, and seven varieties of peanut.

The varieties of cowpea used in this study are: Batac Red, Batao White, Conch, Groit, New Era, Progressive, and Victor. The first two varieties are quite widely grown in some towns of Ilocos Norte and have been introduced in the College quite lately. The last five varieties are of United States origin with New Era as the present standard variety in the College: the other varieties are of recent introduction.

Ami is the standard variety of soybean in the College; it is supposed to have been collected in 1912 by Mr. Ami, a student. Ootoan is of recent introduction from the United States.

All the varieties of mungo used in this study are supposed to be native varieties. Batac Green and *Phaseolus calcaratus* were introduced in the College from Batac, Ilocos Norte. Dull Green (D. N. 568), and Shiny Green (D.N. 570) are strains isolated from a native variety of mungo.

The varieties of peanut studied all belong to the bushy type. Lemery, Spanish, C. N. 3077, and Valencia were introduced from the Bureau of Agriculture; Kinorales, from Bataan; Tarlac, a small podded variety, from Tarlac Province; and Zambales Lupog, from Zambales Province. All these varieties with the exception of Tarlac have been grown in the College for a number of years.

In obtaining the data, about 100 plants at maturity were picked at random from each variety. The individual plants, except in the case of the different varieties of peanut where the plants were carefully dug up, were cut off close to the ground, put in paper bags with proper label and then brought to the laboratory to dry. The air-dry weights of the seed or pod and of the straw of the individual plants were taken as criteria.

No attempt was made in this study to obtain data from rainy season culture. It is planned to do this in later studies.

In this correlation work, the weight of the straw per plant was used as *subject* and the corresponding yield of seed or pod as *relative*.

EXPERIMENTS AND RESULTS

This paper presents correlation data between the seed or pod and straw production of twenty varieties of field legumes. The correlation tables are not here presented but are on file in the Division of Farm Crops in the College of Agriculture.

Table 1 presents the summary of the results of the correlation studies on cowpeas, soybeans, and mungos. Table 2 shows the summary of the correlation studies on different varieties of peanut.

TABLE 1

Showing the coefficients of correlation between seed and straw production of cowpeas, mungo, and soybean

VARIETIES STUDIED	COEFFICIENT OF CORRELATION AND ITS PROBABLE ERROR	SIGNIFICANCE OF CORRELATION
Cowpeas:		
1. Batac Red.....	0.863 ± 0.017	decided
2. Batac White.....	0.857 ± 0.018	decided
3. Conch.....	0.856 ± 0.023	decided
4. Groit.....	0.834 ± 0.021	decided
5. New Era.....	0.812 ± 0.023	decided
6. Progressive.....	0.839 ± 0.021	decided
7. Victor.....	0.721 ± 0.033	decided
Soybeans:		
1. Ami.....	0.936 ± 0.008	decided
2. Ootoan.....	0.859 ± 0.017	decided
Mungos:		
1. Shiny Green.....	0.743 ± 0.035	decided
2. Batac Green.....	0.687 ± 0.036	decided
3. Dull Green.....	0.396 ± 0.056	marked
4. <i>Phaseolus calcaratus</i>	0.926 ± 0.010	decided

TABLE 2

Showing the correlation between the pod and straw production of seven varieties of peanut

VARIETIES STUDIED	COEFFICIENT OF CORRELATION AND ITS PROBABLE ERROR	SIGNIFICANCE OF CORRELATION
1. C. N. 3077.....	0.495 ± 0.051	marked
2. Kinorales.....	0.438 ± 0.055	marked
3. Lemery.....	0.754 ± 0.028	decided
4. Spanish.....	0.647 ± 0.034	decided
5. Tarlac.....	0.582 ± 0.045	decided
6. Valencia.....	0.382 ± 0.058	marked
7. Zambales Lupog.....	0.707 ± 0.034	decided

DISCUSSION OF RESULTS

In the discussion of the results here presented, the rules given by King for the interpretation of the coefficient of correlation according to its relation to the probable error are taken as a guide.

Referring to tables 1 and 2, and applying King's rules, it may be seen readily that the coefficients of correlation between the seed and straw production of cowpea, soybean, mungo, and peanut studied were decided. The coefficients of correlation between the seed and the straw production of cowpea varied from 0.721 ± 0.033 to 0.863 ± 0.017 ; of soybean from 0.859 ± 0.017 to 0.936 ± 0.008 ; and of mungo from 0.396 ± 0.056 to 0.926 ± 0.010 . The coefficients of correlation of the different varieties of cowpea were 0.863 ± 0.017 for Batac Red; 0.857 ± 0.018 for Batac white; 0.839 ± 0.021 for

Progressive; 0.812 ± 0.023 for New Era; 0.721 ± 0.033 for Victor; 0.834 ± 0.021 for Groit; and 0.856 ± 0.025 for Conch. Of the soybeans, variety Ami had a correlation of 0.936 ± 0.008 while variety Otootan had 0.859 ± 0.017 . Among the mungo varieties the coefficients of correlation were: Shiny Green, 0.743 ± 0.035 ; Batac Green, 0.687 ± 0.036 ; Dull Green, 0.396 ± 0.056 ; and *Phaseolus calcaratus*, 0.926 ± 0.010 .

In the case of the seven varieties of peanut studied, the coefficients of correlation between the pod and straw production varied from 0.382 ± 0.058 to 0.754 ± 0.028 . Lemery had the highest coefficient of correlation and Valencia had the lowest. The coefficients of correlation of the different varieties were: C. N. 3077, 0.495 ± 0.051 ; Kinorales, 0.438 ± 0.055 ; Lemery, 0.754 ± 0.028 ; Spanish, 0.647 ± 0.034 ; Tarlac, 0.582 ± 0.045 ; Valencia, 0.382 ± 0.058 ; and Zambales Lupog, 0.707 ± 0.034 . The coefficients of correlation of C. N. 3077, Kinorales, and Valencia were below the 0.5 mark, but the existence of correlation, according to King's rules, was still a practical certainty.

That the degree of association between the seed and straw producing power of the different legumes studied varied considerably is very evident. This variation may be due to the degree of purity of the different varieties studied. While Williams and Park (1917) report that, in the case of soybean, the highest seed yielders had a comparatively low proportion of straw to seed, the data on the two varieties of soybean, at least, indicate that in the different strains within the varieties, the seed and straw yield characters have a decided correlation.

The data presented in this paper show the possibility of isolating varieties or strains of cowpea, soybean, mungo, and peanut that are both heavy yielders of seed and of straw. The knowledge that there exists a marked if not decided correlation between the seed yield character and the straw yield character of the crops mentioned above would aid greatly in their amelioration.

SUMMARY OF CONCLUSIONS

The data reported in this paper seem to justify the following conclusions:

1. Of the twenty varieties of field legumes studied, there existed a positive correlation between the seed and straw production.
2. Among the seven varieties of cowpea and two varieties of soybean, the correlation between the seed and straw production was very decided. The correlation values varied from 0.721 ± 0.033 to 0.863 ± 0.017 in the case of cowpea, and from 0.859 ± 0.017 to 0.936 ± 0.008 in the case of soybean.
3. Of the four varieties of mungo, one showed marked correlation and three gave decided correlation.

4. Of the seven varieties of peanut, four showed decided association between the pod and straw production while three varieties exhibited marked correlation only.

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REPORT ON RECUPERATIVE GROWTHS WITHIN A YEAR OF SOME PLANTS INJURED BY A TYPHOON¹

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WITH FIVE TEXT FIGURES

This report is primarily botanical in nature, but because of the economic value of the plants included, the information it conveys is of practical importance. There is also interest and value in knowing how rapidly plants may recover from serious injuries caused by a severe typhoon. The observations were made soon after the typhoon that occurred during the

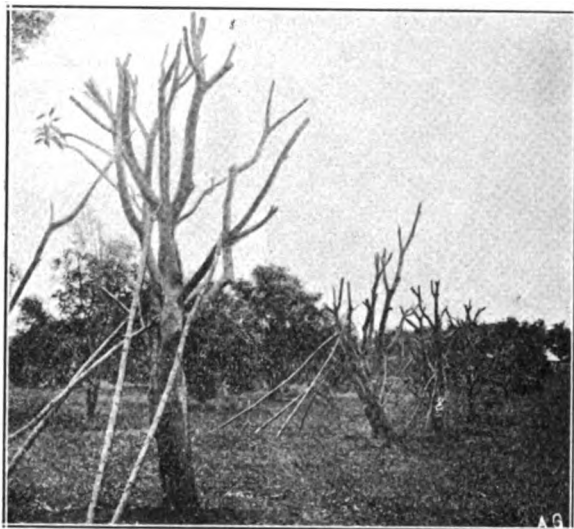


Fig. 1a.—Mango trees, soon after the typhoon.

night of November 5 and 6, 1926, and one year later. This typhoon was one "of unusual intensity". "The College of Agriculture was within the path of the high wind and the destruction on the College grounds was very considerable".

OBSERVATIONS MADE

Mango trees. Four mango trees were blown to the ground. These trees are of different varieties. The first one (see fig. 1a) was *Mangifera*

¹ Experiment Station contribution No. 534. Received for publication on February 8, 1928.

indica var. Carabao. This tree, although it had begun to recover from the damage stands no longer on the spot as construction of a building made it necessary to move it. The second tree in the row is *M. indica* var. Tjenkir, imported from India and was planted on October 6, 1913, so was about 13 years old when the typhoon blew it to the ground. The third mango tree in the row is variety Alfonse, introduced into the College on October 6, 1918, and was 8 years old at the time of the storm. The fourth tree is variety Carabao, planted on July 15, 1916, so was about 10 years old at the time of the storm.



Fig. 1b.—The mango trees shown in fig. 1a, one year later.

Within a few days after the typhoon, laborers in the College cut off all the small branches of these trees so that practically not a leaf was left on them. Then, by means of a device which is described in this report, (see fig. 4), one by one, these trees were raised and propped by wooden poles, (fig. 1a). Some of the large as well as the small roots on the side on which the trees fell were cut off, to facilitate the raising. One week later, new leaves and branches began to appear; one year later, the trees had so recovered that they were able to stand erect without the props. No doubt the damage caused a material setback in the growth of the trees, but they are saved. The loss is far less than if the orchard had been replanted.

Aninapla (Tag); *lañgil* (Tag)², *Albizia lebbek* (Linn.) Benth. This tree was blown flat on the ground. It looked after the storm as though it was

² Name given in Merrill, E. D. 1923. An enumeration of Philippine flowering plants. 530 p. Manila: Bureau of Printing.

a complete loss. A force of six laborers raised it up, using the device (see fig. 4). The beautiful top of the tree was cut off leaving only the main trunk. This *Albizzia*, planted about 10 years ago, is a rare tree on the Campus, so no effort was spared to save it. About one-fourth of the root system was damaged, part as a result of the fall of the tree and part was cut off by the laborers in digging a trench by the side of the tree to facilitate the lifting. Once restored to normal position, the tree was left without props, (fig. 2a).

A week later, dormant buds were awakening and new leaves and branches began to appear. It is regretted that the subsequent developmental changes were not noted. That the tree is fast recovering may be seen in figure 2b, this recovery plainly shows that valuable trees blown down by typhoons may be saved.



Fig. 2a.—*Albizzia lebbek*, soon after the typhoon.



Fig. 2b.—The *Albizzia* tree (fig. 2a) one year later.

West Africa oil palm. As with other palms, this plant (fig. 3a) was scarcely damaged by the typhoon. Only a little disorder in the leaves was noticed and even long before the end of the year, the tree was back to its normal state.

Banana plants. Being herbaceous or fleshy, banana plants were severely damaged by the typhoon; the leaves were shredded to tatters, trunk broken and in the case of the large varieties, particularly the Saba, the full grown plants were uprooted. In such cases the plant is a complete loss; for although the plants were raised to normal position, the bunches

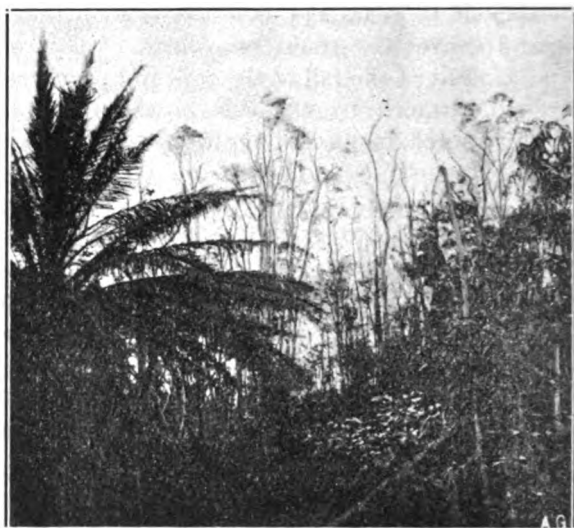


Fig. 3a.—African oil palm and several species of trees, soon after the typhoon.

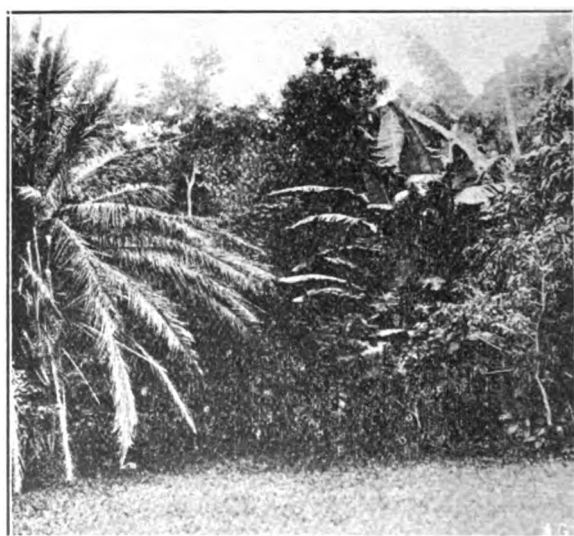


Fig. 3b.—The same plants shown in fig. 3a, one year later.

of fruit produced were so small that they hardly paid for the expense of restoring them. However, the rhizome, or underground stem produced suckers that took the place of those that were blown down. This report is based not only on the few plants shown in figure 3a, but also on small banana plantings in yards in the vicinity of the College. The banana plants recovered rapidly and in three to five months time, the plantings were almost back to the normal condition and, in less than one year, banana fruits in local stores and markets were as abundant as before the storm.

THE LIFTING DEVICE USED

The lifting device that was used to raise the large trees was efficient. Other devices are known and used with mathematical precision, but this one was the product of the ingenuity of six unskilled laborers employed on the Campus. Because of its efficiency and simplicity it is here described.

The device (see fig. 4) consisted of a 2-inch rope, 20 meters in length; two strong bamboo poles, a wooden post, two or three wooden props and wooden pegs. It required six men to operate it properly on large trees; but fewer men may be sufficient if the tree to be lifted is smaller.

The tree (see fig. 4) was lying flat on the ground. A small trench was dug at point *H*, to cut out all damaged roots at that point. One end of the rope *B* was tied around the upper end of the trunk of the tree and the other to a wooden pole *A*, and coiled around the wooden post *C*, one end of which was driven one meter deep in the ground in an inclined position; the post served in a way similar to a capstan on a boat and was held firmly to the ground by the pegs *D*. To help lift the tree, the two bamboo stems *E* were employed as a rider as shown in the illustration.

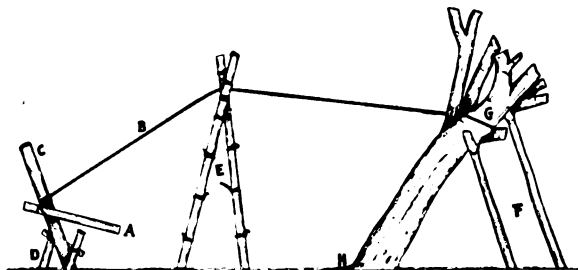


Fig. 4.—The device used in lifting trees to normal position.

Three men rotated post *C*; one man attended to the arrangement of the position of the bamboo posts *E* and another man stationed at *F*, watched that these wooden props were always in such position as to prevent the trunk from falling again to the ground. The post *C* was rotated slowly until the trunk was standing erect or almost so. One man directed the work. It took four hours for six men to raise the trunk of the tree shown in figure 2a.

A COMPARATIVE STUDY OF THE EFFECT OF COPRA MEAL AND DRIED SHRIMPS AS SUPPLEMENTS IN RATIONS FOR LAYING HENS¹

JOSÉ A. SERRANO

WITH ONE CHART

How to increase the egg production of laying hens is one of the principal problems of every poultry raiser. One of the factors that may be considered of importance in attaining this end is the nature of the feeds given. Studies along this line are essential so that the relative effects of various supplemental feeds which are available in the Islands may be determined. Knowledge of this nature should lead to the foundation of a laying ration that will be good and practicable and give the best and most economical results to local poultry raisers.

A number of studies have been carried on the nutritive value of copra meal. Santos (1920) found that copra meal is fairly rich in proteins for it contains over twenty per cent crude protein. However, Derecho (1921) found that guinea pigs fed exclusively with copra meal could not live more than three weeks. Sulit (1926) in his study also with guinea pigs found that thirty-seven per cent copra meal in the feed gave good results. Sulit confirmed the report of Derecho and stated that when copra meal was present in seventy-five to eighty-five per cent, it has a deleterious effect. Crucillo (1926) studying the effects of different amounts of copra meal on laying Native hens found that twenty to thirty per cent copra meal in the ration gave the best results.

Concerning studies on shrimp as feed very little has been done. Many investigators have worked on the effects of animal proteins, such as beef scrap, meat meal, tankage, fresh horse meat, sour milk, fish meal, and others as supplements in rations for laying hens, but so far very little attention has been given to shrimp. Embury (1918) used shrimp in the form of meal fed to fish in combination with different animal and vegetable proteins. He found that a combination of meat meal and shrimp with a small amount of flour is the best and most economical. Santiago (1926) in his work on growing pigs reported that good results were obtained by supplying shrimp as supplement to corn and rice bran in the proportion of from six-tenths to one part shrimp to a mixture of six parts corn and thirteen parts rice bran.

The object of this study was to determine the relative effects of copra meal and dried shrimps as supplements in rations for laying hens. It was

¹Thesis presented for graduation, 1927, with the degree of Bachelor of Agriculture from the College of Agriculture No. 263; Experiment Station contribution No. 535. Prepared in the Department of Animal Husbandry under the direction of Dr. F. M. Fronda.

conducted in the Department of Animal Husbandry, College of Agriculture at Los Baños. The experiment was started on August 29, 1925, and ended on August 27, 1926, covering a period of fifty-two weeks.

MATERIALS AND METHODS

The flock

Cantonese pullets were used in this study. The pullets were almost of the same age having been hatched in the same season of the year.

The house

Three pens, 2.75×3.65 meters with a pasture 12×30 meters adjoining each, were used. Twenty Cantonese pullets and one cockerel were placed in each pen and designated as lots 1, 2, and 3. Each pen was provided with six trapnests and feeding and bamboo drinking troughs.

Feeds and feeding

The feed consisted of grain and mash fed, as much as possible, fifty-fifty by weight. The ration containing twenty-five per cent copra meal which is considered to be the best proportion (Crucillo, 1926) was compared with dried shrimps. In a basal ration with twenty-five per cent copra meal, the amount of proteins is equal to the same ration containing 7.62 per cent shrimp. The dried shrimps used here were fresh water shrimps belonging to the species *Palaemon lanceifrons* Dana. Some small snails and a small fish known as goby (*Glossobins giurus*) were mixed with these shrimps (Santiago, 1926).

The grain part of the feed for all the lots was the same, and was composed of one part by weight of cracked corn and one part of palay. The basal mash consisted of three parts by weight of rice bran and two parts by weight of corn meal. One per cent of common salt was added to the total mash.

In addition to the basal mash the following were given: five parts by weight of copra meal to lot 1, one and four-tenths parts by weight of shrimp to lot 2, and two and five-tenths parts of copra meal and seven-tenths part of shrimp by weight to lot 3. Lot 3 was used as the check lot.

One-third of the whole amount of the grain was given in the morning and two-thirds in the afternoon. Dry mash was open to the birds at all times, and if found necessary wet mash was given between eleven and twelve o'clock. If the birds ate only a little of the mash the amount of grain was reduced so that they would eat more mash. The birds had access to fresh water at all times.

BREAKING THE BROODINESS OF THE HENS

Each pen was provided with a broody coop. As the birds were not allowed to sit on their eggs, broodiness was broken by confining them in the broody coop for four or five days.

Observations on the hens

The birds were weighed at the beginning of the experiment. Monthly weighings were made thereafter to find whether the birds were gaining or losing in weight. Birds found to show any signs of sickness or birds not in good condition were isolated and treated. In case of sickness from an unknown cause, the bird was sent to the Veterinary hospital for treatment.

Testing the fertility of the eggs

The eggs were artificially hatched in a 250-egg Queen hot water incubator. Three settings were made. The first was put down on December 23, 1925, the second, on January 1, 1926, and the third, on March 27, 1926. In accordance with the recommendation of Leoncio (1924) no eggs that were more than ten days old were used.

Observation of the chicks

Forty-eight hours after hatching, the chicks were weighed before they were put down, and then at four week intervals for twelve weeks. A Queen coal stove brooder with a capacity of 500 chicks was used to supply the heat needed by the chicks during the first week. The brooder was placed in a small rat-proof brooder house, 3.25×3.6 meters in size.

RESULTS

Egg production of the different lots

The individual egg production ranged from zero egg to 147 eggs a year. Two birds, one in lot 1 and one in lot 2, did not lay an egg throughout the period covered by the experiment. No bird in lot 1 produced more than one hundred eggs a year. In lot 2, eight birds produced more than one hundred eggs a year. In lot 3, which is the check lot, four birds laid more than one hundred eggs a year. The highest egg layer was in lot 2.

The monthly percentage of egg production of the different lots is given in table 1. These data are graphically shown in chart 1. The monthly percentage of egg production of the different lots was determined by dividing the actual number of eggs laid by the birds in each lot during the month by the number of possible eggs, which is assumed to be an egg every day by each bird, and multiplying the result by 100.

TABLE 1
Showing the percentage of egg production of each lot each month

MONTHS	LOT 1 (COPRA MEAL)	LOT 2 (DRIED SHRIMPS)	LOT 3 (CHECK)
	<i>per cent</i>	<i>per cent</i>	<i>per cent</i>
September.....	15.10	12.80	15.10
October.....	8.38	19.50	17.80
November.....	6.50	21.40	13.40
December.....	15.80	24.30	22.60
January.....	20.10	29.03	29.99
February.....	21.03	31.78	28.38
March.....	11.23	32.59	33.44
April.....	14.70	30.50	22.60
May.....	11.29	30.89	22.39
June.....	16.04	25.00	17.19
July.....	13.50	25.29	19.86
August.....	17.34	22.41	21.71

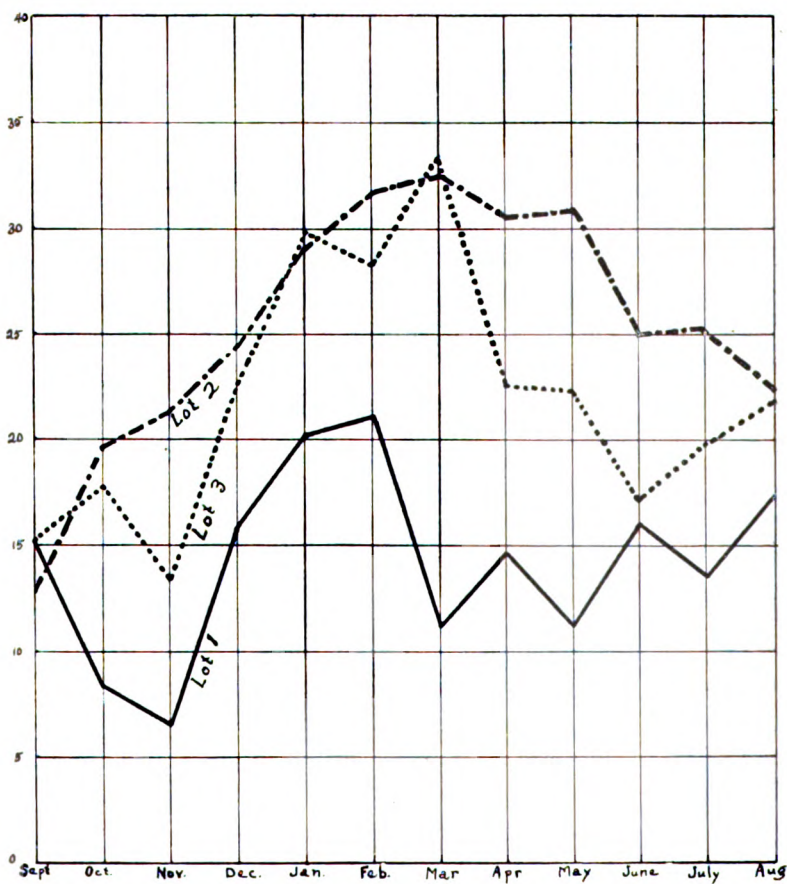


Chart 1.—The monthly percentage of egg production in the three lots.

As may be seen from table 1 the copra meal and the check lots gave a high percentage of egg production during the first month of the experiment, but the shrimp lot was low. During the succeeding month, lot 1 (copra meal) dropped down and lot 2 (shrimp) increased considerably. Throughout the year lot 2 gave the highest percentage of egg production. Lot 3 (check) was always higher in the percentage of egg production than lot 1.

TABLE 2
Egg production per hen and weight of eggs

	LOT 1 (COPRA MEAL)	LOT 2 (DRIED SHRIMPS)	LOT 3 (CHECK)
Total eggs laid.....	946	1772	1546
Total number of eggs weighed....	933	1749	1519
Total weight of eggs in grams....	36368.34	67826.22	59180.24
Average weight of egg in grams....	38.98	38.78	38.96
Average yearly production per hen.....	59.51	92.64	81.74

Table 2 shows the egg production per hen and weight of eggs of the different lots. There was no apparent difference in the average weight of eggs. Lot 2 produced an average of 92.64 eggs per hen in the year, lot 3, 81.74 eggs, and lot 1, only 59.51 eggs, the lowest of the three lots.

Feed consumption

Average consumption per hen. From table 3 it may be seen that each of lots 2 and 3 consumed more feed than lot 1. This difference was partly

TABLE 3
Feed consumption of the different lots

	LOT 1 (COPRA MEAL)	LOT 2 (DRIED SHRIMPS)	LOT 3 (CHECK)
	<i>kgm.</i>	<i>kgm.</i>	<i>kgm.</i>
Total grain consumed.....	267.80	291.50	290.40
Total mash consumed.....	206.60	248.60	242.70
Average grain consumed per hen in the year.....	15.11	15.11	15.24
Average mash consumed per hen in the year.....	11.32	12.97	12.74
Average feed consumption per hen in the year.....	26.43	28.08	27.98

due to the fact that in the latter part of the experiment there were only fifteen birds in lot 1, while lots 2 and 3 had nineteen birds each. The average yearly feed consumption of each hen shows no appreciable difference in the grain portion of the feed. There was however a little difference in the mash consumption, perhaps because the ration with shrimp is more palatable than the feed with no shrimp. Lot 1 consumed a less amount

of mash than either lot 2 or 3. On the total feed consumption per hen in the year, lot 2 was the highest and lot 1, the lowest.

Relative cost of feed used and of eggs produced

In the computation of the cost of feed the price used was the average cost of the feed from the time the experiment was begun until it was closed, as supplied by the Department of Animal Husbandry. They are as follows:

<i>Feeds</i>	<i>Cost per kilogram in centavos</i>
Corn.....	0.0876
Palay.....	0.115
Rice bran.....	0.059
Copra meal.....	0.0696
Shrimp.....	0.229
Salt.....	0.027

The price of eggs was 72 centavos a dozen.

As shown in table 4, lot 1 consumed ₱32.50 worth of feeds and produced eggs valued at ₱56.76, giving a gain over the cost of feeds of ₱24.26. Lot 2 consumed ₱56.42 worth of feeds and produced eggs valued at ₱106.32, giving a gain over the cost of feeds of ₱49.90. Lot 3 consumed ₱50.61 worth of feeds and produced eggs valued at ₱92.76, giving a gain of ₱42.15 over the cost of feeds. The profits above the cost of feeds per hen were: ₱2.04 in lot 1; ₱2.62 in lot 2; and ₱2.24 in lot 3.

TABLE 4

Relative cost of feed used and of eggs produced in the year

	LOT 1	LOT 2	LOT 3
	<i>pesos</i>	<i>pesos</i>	<i>pesos</i>
Total value of feeds consumed.....	32.50	56.42	50.61
Total value of eggs produced.....	56.76	106.32	92.76
Profit above cost of feeds.....	24.26	49.90	42.15
Value of eggs produced per hen at six centavos each.....	3.54	5.56	4.90
Value of feed consumed per hen.....	1.50	2.93	2.66
Profit above cost of feeds per hen.....	2.04	2.63	2.24

Observations on the hens

The average weight of hens at the beginning and at the close of the experiment are given in table 5.

TABLE 5
Average weight and growth of hens

	LOT 1	LOT 2	LOT 3
	<i>grams</i>	<i>grams</i>	<i>grams</i>
Total weight of hens at the beginning of the experiment.....	20,750.00	21,100.00	21,700.00
Average weight of hens at the beginning of the experiment.....	1,037.00	1,055.00	1,085.00
Total weight of hens at the close of the experiment.....	17,900.00	24,750.00	23,000.00
Average weight of hen at the close of the experiment.....	1,193.00	1,303.00	1,290.00
Average increase in weight per hen.....	156.00	248.00	125.00

It will be noted that at the beginning, lot 1 had the highest average weight with lot 2 the second highest, and lot 3, the lowest. At the close of the experiment the birds in lot 2 were the heaviest and those in lot 3 the lightest. For the entire period of the experiment lot 2 had an average increase of 248 grams, lot 1, 158 grams, and lot 3, only 125 grams.

Mortality of the hens. Table 6 gives the percentage of mortality of the birds in the different lots. Five birds died in lot 1, one in lot 2, and one in lot 3. Expressed in percentage, the mortality is thirty for lot 1, five for lot 2, and five for lot 3.

TABLE 6
Percentage mortality of hens

	LOT 1	LOT 2	LOT 3
Number of hens at the beginning of the experiment...	20	20	20
Number of hens at the close of the experiment.....	15	19	19
Number of hens that died.....	5	1	1
Percentage of mortality.....	30	5	5

Fertility and hatchability of eggs

Table 7 gives a summary of the results of the incubation of the eggs. From this table it may be seen that lot 2 gave the highest percentage of infertile eggs, with lots 1 and 3 nearly equal. This shows that there were more infertile eggs laid in lot 2 than in either of the other two lots. Lot 3 gave the highest percentage of D_1 (germs that died during the first week of incubation); lot 2, the lowest. Lot 1 gave the highest percentage of D_2 (germs that died during the second week of incubation) and lot 3, the lowest. The percentage of D_3 (eggs that failed to hatch) was highest in lot 3 and lowest in lot 2. Lot 2 gave 48.91 per cent hatch which was the highest, lot 1 with 43.14 per cent was second, lot 3 with 36.19 per cent, the lowest.

TABLE 7
Fertility and hatchability of eggs

	LOT 1	LOT 2	LOT 3
Total number of eggs set.....	102	184	152
Percentage of infertile eggs (from all eggs set)...	11.76	14.67	11.84
Percentage D ₁ (from all the eggs set).....	12.75	11.96	14.47
Percentage D ₂ (from all the eggs set).....	7.84	7.07	6.58
Percentage D ₃ (from all the eggs set).....	24.51	17.39	30.92
Percentage (hatch from all the eggs set).....	43.14	48.91	36.19

Observations on the chicks

Weight and growth of the chicks. Observations on the chicks were recorded from the time the chicks were hatched to the time they were twelve weeks old. Table 8 gives the summary of the weight and growth of the chicks. There were no appreciable differences in the weight of the forty-eight hour old chicks. In the copra meal lot the chicks showed slightly more vigor than in the other two lots as indicated by their more rapid increase in weight.

TABLE 8
Weight and growth of chicks

AGE OF CHICKS	LOT 1		LOT 2		LOT 3	
	Number of chicks	Average weight	Number of chicks	Average weight	Number of chicks	Average weight
		<i>grams</i>		<i>grams</i>		<i>grams</i>
Forty-eight hours.....	44	23.24	90	24.86	55	22.46
Four weeks.....	37	86.68	79	65.19	51	78.31
Eight weeks.....	35	172.35	73	156.03	49	169.98
Twelve weeks.....	34	329.44	69	313.04	48	324.56

Mortality of the chicks. Table 9 gives the percentage of mortality at four weeks intervals and the number of chicks that died during the twelve weeks of observation. It may be noted that in all the lots the mortality of the chicks was high during the first four weeks, but in all cases for the period of observation the mortality may be considered as normal. Enerva (1926) and Dañgilan (1926) found that the critical period in the life of both the Native and Cantonese chicks was during the first four weeks after they were hatched.

TABLE 9
Mortality of chicks

AGE OF CHICKS	LOT 1			LOT 2			LOT 3		
	Number of chicks	Number of deaths	Percentage mortality	Number of chicks	Number of deaths	Percentage mortality	Number of chicks	Number of deaths	Percentage mortality
Forty-eight hours.....	44	—	—	90	—	—	55	—	—
Four weeks.....	37	7	15.91	79	11	12.22	51	4	7.27
Eight weeks.....	35	2	5.41	73	6	7.59	49	2	4.08
Twelve weeks.....	34	1	2.86	69	4	5.62	48	1	2.04

DISCUSSION OF RESULTS

From the results obtained in this experiment a decided influence of the dried shrimp on egg production was shown. The rations having practically the same amount of proteins would logically give about the same egg production. But the shrimp lot produced many more eggs than the other two lots; and this superiority can be credited only to the nature of the source of protein. It may be noted that at the beginning of the experiment the copra meal lot produced the most eggs, but decreased later. This decrease may be due to the stimulating effect of the toxic substance in the copra meal, an effect observed also by Taleon (1924).

Frona (1919) using snails realized ₱2.31 over the cost of feeds from the lot fed with animal proteins; while the copra meal lot showed a loss of ₱6.43. Kaupp (1921) concluded as a result of his investigations that it is not wise to keep birds for egg production unless some form of feed containing animal proteins is given.

The results found in this study once more proved the superiority of animal proteins over those from vegetable sources. This superiority may be because vegetable proteins do not carry the amount of mineral elements necessary for growth and egg production, as was claimed by Kennard and White (1922) who obtained satisfactory results with vegetable proteins when supplemented with suitable mineral mixtures.

This experiment showed also that the lot fed with animal proteins gave the highest production and profit. The low production of the shrimp lot in the beginning may be because the birds were not yet accustomed to the new kind of feed. In the fertility of the eggs and the growth of the chicks, the copra meal lot was better than the shrimp and the check lots. The copra meal lot had the lowest percentage of mortality. The same result was also found by Ahrens (1917). Philips, Carr, and Kennard (1918) found that for growing chicks fed the basal ration of ground corn and corn meal as grain and a mash of corn bran, ash, and charcoal, meat scrap was somewhat inferior to soybean meal or to the combination when 10 per cent protein from soybean meal was added. But in the percentage of hatch from all the eggs set, the shrimp lot was higher than the copra meal and the check lots. This high rate was owing to the high percentage of eggs that failed to hatch in the copra meal and the check lots.

SUMMARY AND CONCLUSIONS

1. There was a gain in weight of the hens in the three lots. The highest was in lot 2 (shrimp lot), with lot 1 (copra meal lot) as second, and lot 3 (check lot), the lowest.

2. On the average, the hens from each lot consumed equal amounts of the grain feed given to them. Lot 2 consumed the most mash feed and lot 1, the least. In the total average consumption per hen there was but little difference.

3. Lot 2 produced the highest number of eggs per bird, 92.64, followed by lot 3 with 81.74, and lot 1 with 59.51, the lowest.

4. There was no appreciable difference in the size of the eggs produced in the three lots.

5. Lot 1 gave the highest percentage of fertile eggs. Lot 2 gave a high percentage of infertile eggs, a percentage higher than either of the other two lots.

6. The chicks hatched from lot 1 were more vigorous and grew slightly faster than those in either lots 2 and 3. This would appear to show that copra meal has some influence on the growth of the chicks.

7. A gain of more than two pesos per hen in one year over the cost of the feed was registered in each lot. Lot 2 gained fifty-eight centavos more than lot 1 and thirty-eight centavos more than lot 3.

8. The results gathered here show that dried shrimp is much better than copra meal when used as supplement in rations for laying hens.

9. Although the price of the feed consumed by lot 2 was high, yet the lot yielded more profits than either of the other two lots.

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A COMPARATIVE STUDY OF CORN AND CASSAVA AS FEEDS FOR HOGS:

II. GROUND CORN VS. RAW CHOPPED CASSAVA¹

MARIANO MONDOÑEDO

Of the Department of Animal Husbandry

The feeding trial here presented is a continuation of the report by Mondoñedo and Bayan (1925) on the comparative value of corn and cassava. In the previous work the cassava used was peeled and cooked; in the present work it is used raw and unpeeled. The experiment was conducted in the Department of Animal Husbandry, College of Agriculture, Los Baños, Laguna, beginning May 17, 1927, and covering a period of 70 days.

PIGS USED

The pigs used, consisting of 10 gilts, were eight months old at the beginning of the experiment. They were College bred Berk-Jalas.

RATIONS USED

The rations used were as follows:

	<i>Lot I</i>	<i>Lot II</i>
Corn.....	20 parts	—
Cassava.....	—	20 parts ²
Rice bran.....	70 “	70 “
Copra meal.....	8 “	8 “
Shrimps.....	2 “	2 “
Total.....	100 “	100 “

One per cent of a mineral mixture consisting of equal parts corn-cob-charcoal and common salt was added to each ration.

The prices of the feeds at the time this test was conducted were as follows:

Corn.....	@	6.7 centavos a kilogram
Rice bran.....	@	5.0 centavos a kilogram
Copra meal.....	@	5.0 centavos a kilogram
Cassava.....	@	2.0 centavos a kilogram
Shrimps.....	@	22.0 centavos a kilogram

¹Experiment Station contribution No. 536. Received for publication May 7, 1928.

²Two parts by weight of unpeeled, raw (chopped) cassava was used in lot II and 1 part corn in lot I as equivalents.

The price of the corn mixture was 6.68 centavos a kilogram; cassava mixture, 5.64 centavos a kilogram.

The varieties of cassava used were the Angular and the Kapo White.

MANAGEMENT

The pigs in both lots occupied together a pen with a small yard adjoining. They had access at all times to a vacant pasture lot where they could exercise and graze. Growth of edible grasses was, however, poor and scant during the test. The animals were separated only at feeding time—at 6:00 a. m. and at 4:00 p. m. They were fed all they could easily clean up. They had access to water in troughs and to shade at all times. The hose was turned on them once or twice a day to keep them cool. Partial weights were taken every ten days.

Table 1 summarizes the results obtained in the test:

TABLE 1
Showing results of tests

	(LOT I)	(LOT II)
CORN.....	20	CASSAVA..... 20
RICE BRAN.....	70	RICE BRAN..... 70
COPRA MEAL.....	8	COPRA MEAL..... 8
SHRIMPS.....	2	SHRIMPS..... 2
Number of pigs.....	5	3
Duration of test.....	70 days	70 days
Average age of pigs.....	8 months	8 months
Average initial weight of pigs.....	33.06 kgm.	32.64 kgm.
Average final weight of pigs.....	58.52 "	60.36 "
Average gain per pig.....	25.46 "	27.72 "
Average daily gain per pig.....	0.364 "	0.396 "
Feeds consumed per pig.....	110.00 "	132.00 "
Feeds consumed per kilogram gain.....	4.32 "	4.76 "
Feeds cost per kilogram gain.....	P 0.28	P 0.26

The results showed that: (1) the cassava lot made faster and greater gains than the corn lot; (2) the consumption of the cassava lot was 9 per cent greater than that of the corn lot; (3) the cost per 1 kgm. gain was 2 centavos less in the cassava lot, a saving of 11 per cent from the cost of feed to make the gains; and (4) from the standpoint of slaughter for pork the corn lot turned out to be the better finished hogs, but from the breeder's standpoint the cassava lot gave more active and growthy pigs.

It is interesting to note that while cassava in the proportion used contained 26 per cent less dry matter than corn, better results were obtained from the use of cassava than from corn. The beneficial effect of roots, such as sweet potatoes, turnips, carrots, etc., upon live stock when fed in conjunction with other concentrates is of common knowledge among stockmen. It is evident that cassava, like other roots, contains something, at present unknown, which gives it a feed value higher than what might be normally

expected from its dry matter content. Or it is possible that cassava (and other roots) induce better utilization of the other ingredients of the ration.

The pigs on cassava did not show any evidence of poisoning resulting from feeding the cassava raw and unpeeled.

In our previous work it was found that on the basis of three parts of peeled cooked cassava, which is equivalent to two parts of raw cassava, flint yellow corn and cassava had approximately the same feeding value. In using the same proportion in the present work, that is, 1 part corn for 2 parts of raw cassava it was found that cassava and corn produced about the same results in the amount and rate of gains, corroborating our previous results. The advantage of using cassava instead of corn is in the cost of gain which is slightly in favor of cassava and its suitability for feeding breeding pigs where growth is to be desired rather than fattening.

A direct comparison of raw cassava and cooked cassava will be the object of our next study.

SUMMARY

1. Raw chopped cassava with other feeds as used in this experiment gave a faster, greater, and more economical gain than ground corn.

2. Cassava alone or in combination with the feeds used in this experiment is just as palatable and appetizing as ground corn.

3. Throughout the feeding period there was no evidence of poisoning effect of cassava on the pigs fed. The Kapo White and Angular varieties of cassava, the ones used in this experiment, therefore, can be fed raw and unpeeled.

4. Judging from results obtained in the two studies reported (I and II) the use of cassava may be recommended for growing breeding pigs in dry lot or on poor pasture.

THE BAKER MEMORIAL FUND

Dean Charles Fuller Baker was ever opposed to ostentation. He was a firm believer in the principle or doctrine that the care of the human being should take precedence over ornate works of art in a community.

The movement of the College of Agriculture to express gratitude for the Dean's devotion to the institution and his great services in its development and the development of the Philippines and his incalculable contribution to Malayan Entomology by a permanent fund to provide aid for self-supporting senior students in the College is carrying out this belief and practice of Dean Baker.

The following announcement and appeal was sent by the Baker Memorial Committee to all the newspapers in the Philippines. By letters and other means, the committee is supplementing this appeal. It is hoped that every one who knew of Our Dean's long years of unselfish labor will help make this fund a worthy memorial to "an extraordinary man," a "man who ran a great race," "a great scientist," "a great teacher," a "maker of men."

BAKER MEMORIAL AT THE COLLEGE OF AGRICULTURE

The late Dean Charles Fuller Baker believed strongly in the youth of the Philippines; he never failed to come forward in their defense and in their aid. While Dean of the College of Agriculture he did all he could to develop the best type of manhood in the students. The Dean used to say that when he saluted the boys, he was saluting the leaders ten or fifteen years hence.

The Dean was particularly interested in the Self-Supporting Students who came from all parts of the Islands, determined to secure an education. He helped these students in every way possible, oftentimes, financially.

To perpetuate this kind thought of the Dean for the Self-Supporting Students, the Faculty of the College of Agriculture unanimously voted to raise a trust fund to be deposited in perpetuity in some safe investment the interest to be used to help deserving seniors working their way in the College of Agriculture.

We appeal to the members of the faculty, past and present, to the alumni, and to all students who have ever registered in the College of Agriculture, to all friends of Dean Baker, and to those who have at heart the cause of self-supporting students with which the late Dean so identified himself to help us in this campaign that the memory of him who so nobly served may be perpetuated.

Send contributions to Secretary-Treasurer of the Committee. A receipt for remittance will be mailed to contributor.

THE COMMITTEE,
(Signed) EMMA S. YULE, *Chairman*
VICENTE C. ALDABA, *Member*
INOCENCIO ELAYDA, *Member*
MANUEL L. ROXAS, *Member*
L. B. UICHANCO, *Member*
TORIBIO VIBAR, *Secretary-Treasurer*

EXTENSION DIVISION NOTES

Prepared by Moises M. Kalaw under the supervision of Professor I. Elayda

The Occidental Negros Carnival

In the last issue, under this column, mention was made of the Occidental Negros Carnival. Professors Roxas and Uichanco of this College were invited as guests of the Carnival authorities to give lectures on some phases of the Philippine sugar industry. They were very much impressed with this instructive provincial carnival. They said that in magnificence it is comparable to the annual national carnival held in Manila. It was a complete success in every respect, very enjoyable and highly instructional. Two booths in the carnival presented miniature sugar centrals complete in all parts of a central and in actual operation. The sugar cane industry was presented in a way far beyond any exhibit given in the past in the Islands. It has been commented that if all provincial carnivals would be as instructive as this one in Negros they are well worth the money and effort spent on them.

Abaca Investigation

At about this time last year Professors Aldaba and Elayda made a tour of Leyte investigating the abaca industry. On their return they submitted a report bringing out facts about the abaca industry which had not been reported before. Besides the discussion of local conditions related to abaca growing the report discussed the possibilities of foreign competition with the local abaca industry. It stated that the danger of the possible foreign competition is not as grave as feared by many. One of the interesting facts mentioned was about the stripping of coarse grades of fiber. It was found that the strippers prefer stripping coarse grades to stripping fine grades because conditions being equal they earn more by stripping the coarse grades. However, the plantation owners lose a great deal in the stripping of coarse grades, and consequently they prefer the stripping of fine grades. So in this particular instance and under Leyte conditions the stripper gains where the planters lose and vice versa. But the planters are at the mercy of the strippers, and this explains the existence of a great amount of coarse grades in the market. This report is now very widely published. It has been published in full in the *Bureau of Commerce and Industry Journal*. It was also published in part in the *Philippines Herald* (a local daily) in its issue of May 8, 1928.

Inquiry on Tobacco Experiments

The Samson brothers who own a large tobacco hacienda in Isabela Province and engage in cigar manufacture and in selling tobacco leaf out of their own hacienda output, called at the College of Agriculture recently. They were seeking information on several features of tobacco production. They particularly wanted to know the possibility of producing locally a uniform crop of wrapper leaves and a special type of tobacco for cigarette purposes.

Professors Lava and Elayda met the visitors and showed them samples of tobacco materials that are being experimented with in both the Department of Agronomy and Department of Chemistry through their respective classes. Although this experimental work is but a part of class instruction, it has the ultimate object of helping in the solution of our pressing problems in producing locally what at present is being imported in great quantities to meet the demand of local tobacco factories.

The College faculty who are qualified are willing to coöperate with the Samson brothers or others in their enterprises, provided that they are permitted to do so by the higher authorities of the University. Messrs. Samson were furnished tobacco seeds of the varieties cultured on the College Farm, samples of which appealed to them as desirable types of wrapper tobacco and worth trying in their hacienda to secure the results in which they are interested.

EXCHANGE NOTES

Verbal understandings are poor substitutes for written contracts. Your business relations should be protected. Don't take too much for granted. Your patrons may have the utmost confidence in you and it may be agreeable to them to just let certain matters ride along, but the time may come when a written agreement will come in mighty handy. Do business in a businesslike manner always.

—*Butter, Cheese and Egg Journal* (Wisconsin).

One of the main problems with regard to the producer in the tropics and particularly with the small man is that however proficient he may be as an agriculturist he often does not reap the benefit of producing goods of first class quality. Many of the small growers and peasants sell for what they can get in the local markets to agents of trading organizations which in turn dispose of the produce after it has been graded and packed by them. The good produce, however, finds its way initially amongst the bad and

it is the trader that benefits, and not the producer, by standardizing what he has bought. . . .

There is no single remedy that can be applied to the inefficiencies or inadequacies of the existing systems of marketing. All that can be done is to organize, applying this term in its widest sense. Growers of tropical produce should confine their attention to this word "organization," adopting, if possible, co-operative methods which would improve their standard of produce and its presentation and thereby ensure higher prices, eliminate waste in transport, handling and merchandising and regulate the quantity and quality of the produce put on the market. . . .

—*Tropical Agriculture.*

In California last year 81,500 acres were fumigated and 54,000 acres of citrus were sprayed for various insects at a total cost to the growers of that State of £730,000 (£7,300,000, about), according to a statement recently made by R. S. Woglin, Entomologist of the California Fruit-growers' Exchange.

—*Journal of Agriculture* (Victoria).

Did you ever use a flashlight in your poultry work? Next time you test eggs just run a flashlight under the tray and pick out the poor ones. I test 600 eggs in less than 10 minutes. If you get up at night to look at your incubator a flashlight is handier than a match. When you go to the brooder house after dark carry a flashlight. You can throw the light on the chicks and see if they are all right and throw it off before you rouse the whole brood. A flashlight is about the handiest tool the poultry raiser can have.

—*Capper's Farmer* (Kansas).

Immediate arrest of all fruit dealers and grocers found selling immature avocados will be made. The plea of ignorance will not be accepted by inspectors, but when immature fruit is found on a stand the avocados will be seized and held and the dealer cited to appear in court is the warning of both state and county horticultural offices. The law imposes a fine of not less than \$50 nor more than \$500 or six months in jail for selling or having for sale avocados having less than eight per cent of oil.

—*California Cultivator.*

America, far more so than Europe, is paying careful attention to our pleadings to encourage the cultivation of the better and best grades of cacao, and to increase consumption by lowering costs through enlarging the outputs on the estates.

—*Tropical Life.*

Three leading sugar experts have planned an aeroplane expedition to New Guinea under the auspices of the (U. S.) Department of Agriculture to seek hardier classes of sugar cane than the present American varieties. Dr. E. Brandes, a member of the sugar plant section of the Department, will fly to San Francisco shortly in a Fairchild cabin monoplane, and he will meet Dr. Jakob Peswiet, director of sugar experiments in Java for the Dutch Government. They will be joined at Hawaii by Mr. C. Pemberton (an entomologist), whose plane will be shipped to Sydney from San Francisco.

—*The Australian Sugar Journal.*

Speaking to a gathering of representative sugar producers in Brisbane recently the Premier, Mr. W. McCormack, said, in the course of a notable address, that there were very few agricultural industries in which there was such a wide distribution of the wealth produced as in the sugar industry. All sections of the community participated in the results of that great industry. It was a good wage payer. It affected transport. Of all agricultural products, sugar, though a very costly agricultural product, provided the greatest distribution of wealth in proportion to the value of the product.

—*Queensland Agricultural Journal.*

COLLEGE AND ALUMNI NOTES

On May 4, 1928, Mr. F. E. Devoto, delegate of the Ministry of Agriculture of the Argentine Republic, visited the College of Agriculture to observe the work being done in sugar cane culture and improvement and in poultry. He was accompanied by Mr. Carlos X. Burgos of the Philippine Bureau of Agriculture. The visitors were shown the cane breeding cultures and the poultry yards by Acting Dean Gonzalez, Doctor Mendiola and Doctor Fronda.

Mrs. J. R. Gillis, formerly instructor in English in this College, was a Campus visitor for a few days, in April. Mrs. Gillis is now living in Zamboanga where Mr. Gillis is engaged in the logging business.

Dr. Francisco O. Santos, until recently Acting Head of the Department of Agricultural Chemistry, was detailed by the Public Welfare Commissioner as nutrition expert to carry investigation along that line of work in several nutrition institutions of Japan during the summer recess. Doctor

Santos, accompanied by Mrs. Santos, sailed on the *S. S. President Madison* for Japan on March 31. Dr. Vicente G. Lava is in charge of the Department of Agricultural Chemistry in Doctor Santos' absence.

From April 18-20, under the supervision of Doctor Villegas and Instructor Sarao, the class studying Cattle Husbandry made a second trip for field practice to Hacienda del Rosario, Cainta, Rizal.

The class branded 52 animals, and bulls unsuitable for breeding were castrated. The students also practiced lassoing, casting, and roping of animals.

Mr. Amado Balagtas, B. S. '27, Assistant Analyst in the Chemistry Experiment Station for the last two years, has resigned to accept a position as Chief Chemist in a newly erected sugar central in Manaoag, Pangasinan. Mr. Francisco Barros, B. S. '24, has been appointed as his successor in the department.

On March 28, 1928, Mr. Vicente M. Dawis, Instructor in Agronomy in this College, was married to Miss Dolores Villanueva of Amadeo, Cavite. Miss Villanueva is a sister of Mr. Leon Villanueva, B. Agr. '20.

Mr. Getulio Guanzon, B. S. '25, temporarily in charge of the U. P. Sugar Mill, spent two weeks with the Pampanga Sugar Development Co., Inc., during the summer recess. After completing his work in the central, he left for Palawan Province for an extended vacation.

Mr. Esteban G. Collado, Instructor in Chemistry and Manager of the College Students' Mess Hall, was sent in May to Central Luzon Agricultural School at Muñoz to conduct investigation on the diet of students in that institution.

Mr. Sotero Lantican, B. Agr. '26, was a Campus visitor in May. Mr. Lantican, who has been teaching in Leon Academy, Leon, Iloilo, since graduating, spent his summer vacation visiting his parents in San Antonio, Los Baños. Mr. Lantican is the only College of Agriculture graduate from San Antonio. He has also the distinction of being the first Alumnus to contribute to the Baker Memorial Fund.

CO-OPERATION

To all Members of the College of Agriculture.

In all of the internal relationships of members of this staff, as well in technical work as in business matters, I would request fullest possible co-operation in the practical application of the Golden Rule. It is the only means ever devised whereby human relationships may yield permanent peace, solid contentment, or enduring happiness—and consequent effective co-operation. The innumerable petty difficulties and potential causes of friction are overcome and smoothed away, if this Rule is kept clearly in the foreground as a guiding principle—do to others as you would have them do to you. Friction between members of a large staff, where work is so extensively interlocking as it is here, means definite loss to the University, loss in time and loss in results. Smooth and effective co-operation means great results—constructive results—and breeds great hope in all of us. Common courtesy pays tremendous dividends. The constructive criticism necessary to improve conditions at many points can just as easily be clothed in the most impeccable courtesy and kindness—in this guise it may make action attractive when otherwise it might merely produce resentment.

Another common precept, corollary to the above, is worthy of consideration in this connection—"People who live in glass houses should not throw stones". Some of the most difficult problems in the practical operations of any group of human beings arise from disregard of this axiomatic "first aid to peace". We are *all* human and fallible and prone to err, and we had better always remember this, and keep on hand ready for instant use in the many cases of emergency that come up, a generous supply of charity for others.

On the whole we have had a splendid community spirit at Los Baños, and there has been a constant display of fine team work in many connections. In this direction certainly lie the greatest hopes for the development here of a productive and effective College. And naturally this supreme objective is of infinitely greater importance than any mere personal interests—or feelings.

"All hands to the ropes!
All together now! Heave Ho!"

C. F. BAKER (Dated May, 11, 1925)

Dean.

THE MEASURE OF A MAN

Not—
 "How did he die?"
 But—
 "How did he live?"
 Not—
 "What did he gain?"
 But—
 "What did he give?"
 These are the units
 To measure the worth
 Of a man, as a man.
 Regardless of birth!

Not—
 "What was his station?"
 But—
 "Had he a heart?"
 And—
 "How did he play
 His God-given part?
 Was he ever ready
 With words o' good cheer
 To bring back a smile,
 To banish a tear?"

Not—
 "What was his church?"
 Nor—
 "What was his creed?"
 But—
 "Had he befriended
 Those really in need?"
 Not—
 "What did the sketch
 In the newspaper say?"
 But—
 "How many were sorry
 When he passed away?"

—WALLACE GALLAGHER.

The philosopher should be a man willing to listen to every suggestion but determined to judge for himself. He should not be biassed by appearances; have no favorite hypothesis; be of no school; and in doctrine have no master. He should not be a respecter of persons, but of things. Truth should be his primary subject. If to these qualities be added industry, he may indeed hope to walk within the veil of the temple of nature.

—MICHAEL FARADAY.

A GRAVITY GATE, OR A SIMPLE SELF-CLOSING GATE¹

ALEXANDER GORDON

Of the Department of Agricultural Engineering

WITH SIX TEXT FIGURES

Daily observation makes it unnecessary to show the need for a simple self-closing gate in the Philippine Islands. It is not uncommon to find fenced farmsteads with gates thereon. The purpose, however, of fencing is generally defeated because apparently the farmers, or others for that matter, do not have the time or take the trouble to close the gates. It would seem that the only way to have the gate fulfill its purpose is to use one with some simple device that will automatically close it when it is opened. With this in mind, the writer devised a type of gate that will automatically close. The simple gravity gate has no hinges or parts that will get out of place or out of condition.

THE CONSTRUCTION OF THE GATE

The construction of this gravity gate is very simple. A frame gate, as it is commonly constructed, is built. To this gate is attached a pivot piece, which serves as the hinge and is placed at the side on which the gate must swing. (See fig. 1).

The pivot piece is inclined at an angle of from five to ten degrees (5° - 10°) on the vertical. The angle of inclination will depend upon the speed of closing desired. Furthermore, this angle will be limited by space. The

¹Experiment Station contribution No. 537. Received for publication May 24, 1928.

Mr. Pflueger of Philippine Bureau of Forestry gives his opinion of the gravity gate in the following letter:

School of Forestry
Agricultural College
Laguna, P. I.
May 10, 1928.

Dr. Alexander Gordon,
Los Baños Agricultural College,
Laguna, P. I.

Dear Dr. Gordon:

I have seen several types of self-closing gates in the United States, but in my estimation the gravity gate you have shown me is one of the simplest and most efficient that I have ever seen. The fact that it requires no patent devices for closing is, in my opinion, its strongest point.

I am of the opinion that it will be of use in the Philippine Islands.

Very respectfully,

O. W. PFLUEGER
Forester
Chief, Division of Investigation.

farther out the inclination, the narrower the space becomes at the top of the gate. Because of this, it is desirable to have the pivot piece incline a little as possible. (Note the inclination of the pivot pieces in fig. 2 and 3)

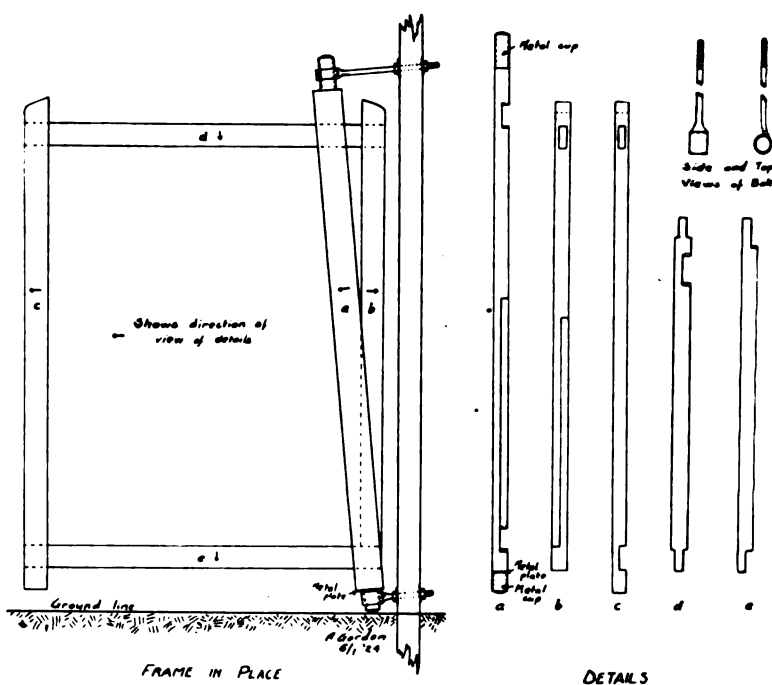


Fig. 1.—Plan of framework of the gravity gate. Note the method of hanging the gate.

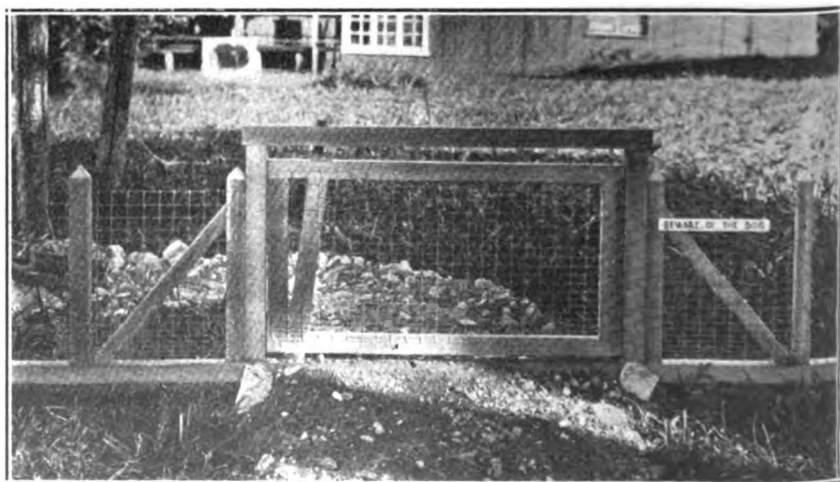


Fig. 2.—Gravity gate of wood, closed. Note the method of hanging the gate.

MATERIALS FOR CONSTRUCTION

This gravity gate may be made of any available material. Bamboo, wood, iron pipes, etc., may be used for the frame. Figure 2 shows a gate of wood; figures 3 and 4 show a gate of bamboo. In figure 4 the gate is shown open. (Note how the gate swings up when opened).

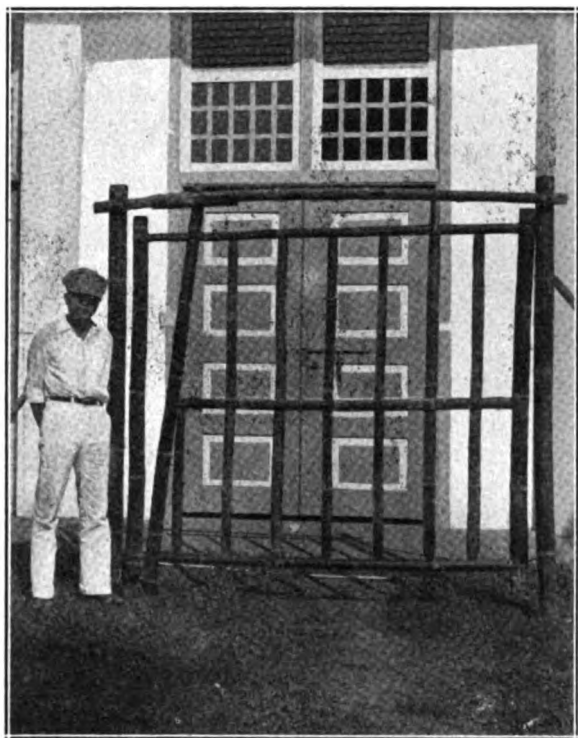


Fig. 3.—A model of the gravity gate made of bamboo, closed. Horizontal pieces of the gate are inserted through the pivot piece.

METHODS OF HANGING THE GATE

The method of hanging the gate hardly matters. In figure 2 the lower end of the pivot piece is in a socket in the ground, and the upper end moves in a socket in the tie beam of the gate.

Figures 3 and 4 show the bamboo gate with the pivot piece attached at the bottom in a bamboo socket while at the top it is attached by a hole in a bamboo joint spliced to the tie beam.

Figure 1 shows a method for attaching a gate quite different from that shown in figures 2 and 3.

METHODS OF FASTENING GATE

There are a number of ways of fastening this gate. If the gate is to be made to swing in and out, then the latch must permit the gate to swing by. But, if it is desired that the gate swing on one side only, then any latch will do, and the gate is hindered from swinging by. There are many patent

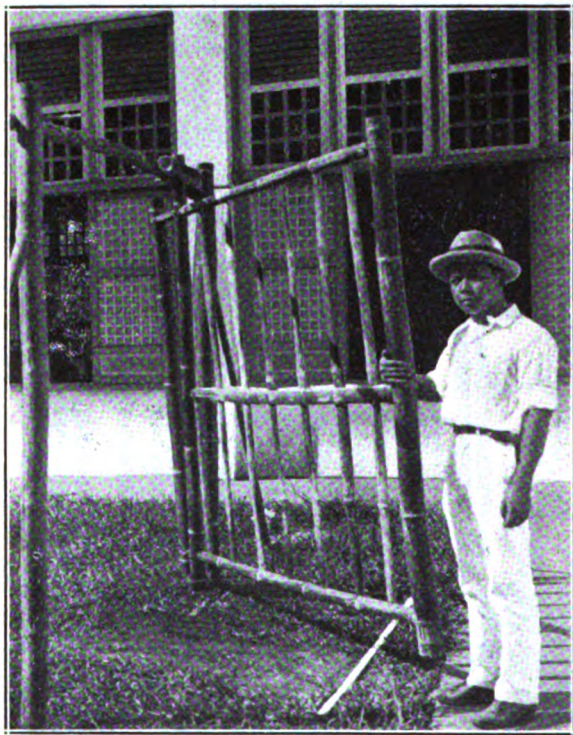


Fig. 4.—The bamboo gravity gate, open. Note method of hanging gate at the top; pivot piece is inserted through a bamboo joint spliced to the cross beam. Note also how gate swings up.

devices of this kind, but for a swinging gate, the one diagrammatically shown in figure 5, is, in the writer's opinion, the one best suited; it can easily be made by any one.

This latch may be made of wood or iron. In figure 5, the lock piece *a* is inserted into *b* which is fastened to the gate post, while *c* is fastened to the gate. As the gate swings by, *a* slides on *c* jumping over the gap if the gate swings fast, and catching if the gate swings slowly.

PRINCIPLE OF THE GATE

In figure 6, let the plane determined by the posts (and tie beam if any) be PQ . PQ , therefore, is perpendicular to the ground plane, being determined by the posts.

Let AB be the plane of the gate. XY is the pivot piece, and lies wholly in the plane AB , being a part of the gate.

XY also lies in plane PQ , being attached to it.

Let n be the intersection of AB with the ground plane.

Divide AB into triangles 1 and 2, and rectangle 3; and let *c. g. 1*, *c. g. 2*, and *c. g. 3* be their respective centers of gravity.

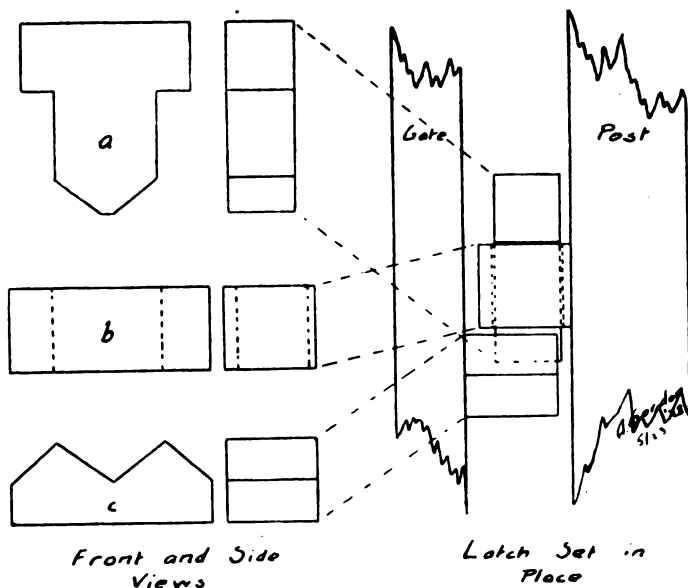


Fig. 5.—Diagrammatic drawing of a latch for a swinging gate.

When the gate is at rest, in a stable state, the lines of the force of gravity on the centers of gravity will cut the intersection n of AB and the ground plane at k , l , and m . Therefore, the lines of the force of gravity on *c. g. 1*, *c. g. 2* and *c. g. 3* must be contained in the plane AB .

The lines of the force of gravity on *c. g. 1*, *c. g. 2*, and *c. g. 3* and XY are coplanar. Since the lines of the force of gravity are perpendicular to the ground plane, then AB which contains them must be perpendicular to the ground plane also. But PQ is also perpendicular to the ground plane and contains XY ; therefore AB and PQ is but one plane. Under this condition, the gate is closed.

Now, let AB swing on XY to any position $A'B'$. Let the intersection of $A'B'$ and the ground plane be n' . Let the corresponding centers of gravity move to $c'.g'.1$, $c'.g'.2$, and $c'.g'.3$.

In the $A'B'$ position, the lines of the force of gravity on the centers of gravity will not fall on the intersection n' of $A'B'$ and the ground plane, but they will cut the ground plane at $k', l',$ and $m',$ respectively. Thus, the force of gravity on $c'.g'.1$ creates a positive moment, and on $c'.g'.2$ and $c'.g'.3$ negative moments.

The moments of the force of gravity on $c'.g'.1$ and $c'.g'.2$ will tend to cancel each other. This being the case, the moment due to the force of

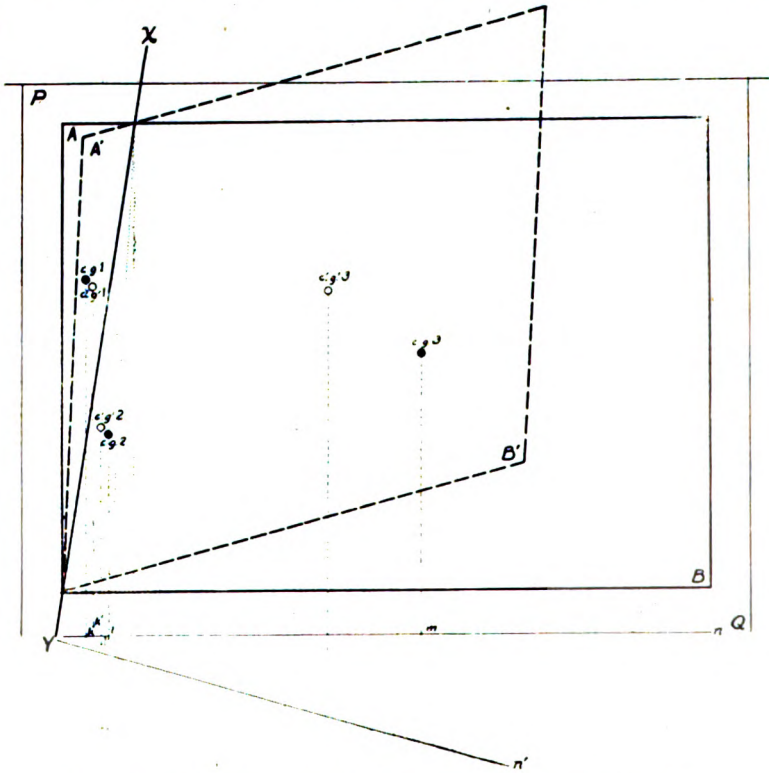


Fig. 6.—A diagram showing the principle of the gravity gate.

gravity on $c'.g'.3$ will be the only effective moment in bringing down $c'.g'.3$ to its original position $c.g.3$. The same moment is the one that brings back the gate to close. Owing to the momentum gathered by the gate on its descent from one side it will swing up on the other side, and vice versa until it finally rests at the original position, AB .

This analysis shows that:

1. The heavier the gate, pivot inclination constant, the faster the gate will swing.
2. The larger the angle of inclination of the pivot piece, all other parts remaining the same, the faster the gate will swing.

CONCLUSION

The writer believes that he has found a gate that will serve a need of long standing on Philippine farms. This gravity gate, because of its simple construction, with no complicated device to get out of order, and easily set up, should have various uses. This gate may be from the heaviest to the lightest type. It may be used for ranches, pens, and for other animal projects that use fencing. The gate is easily adaptable to home use; in short, it is an all-purpose gate that may be used in any place that demands a gate.

As a sanitary measure this gate should be a boon. Hogs, fowls and other animals so often on the streets may be kept shut up with this self-closing gate in the lot fence. This daily menace to health can thus be made a thing of the past. Often these animals are on the streets not because there are no fences on the home lot, but because the gate is not always closed. With the self-closing gate,—it would never be left open.

PROXIMATE CHEMICAL ANALYSIS OF SOME PHILIPPINE SHELLFISH ¹

SEVERINO B. ETORMA

WITH ONE PLATE

INTRODUCTION

There are relatively few towns in the Philippines where shellfish, either salt or fresh water species, are not used as food. There seems to be no good reason for the study of their food value having been overlooked or neglected. The fact that they are in abundance in the Islands probably accounts for the Filipino's attitude of just appropriating what Nature provides regardless of whether or not it is rich in food constituents. This practice may explain the lack of literature on the composition of the shellfish. As years go on and population increases, Filipinos will realize the importance of preserving and propagating those species of shellfish which are of the greatest economic value. In fact a beginning is now manifest in thickly populated regions, such as localities near Manila. Oysters are cultivated in river mouths around Manila, and in the tide flats of Manila Bay, especially in Malabon, Rizal.

An investigation on the food value of shellfish would be of great help to the people using them as food, and also to those who will engage in shellfish industry as they could select species to propagate according to their merits. Had there been information of this kind in the past probably those species of shellfish which are of high nutritive value would have been propagated on a commercial scale or at least protected from their natural enemies.

A glance at the United States oyster business will give a hint of how profitable a shellfish industry may be. Stiles (1910) reports that in 1902 there were 25 million bushels of oysters marketed in the United States, valued at 20 million dollars. In New York City, alone, 6 million bushels of oysters are marketed annually costing 7 million dollars and 45,000 bushels of clams at 90 thousand dollars.

The object of the present work was to determine the proximate chemical composition of some Philippine shellfish with a view to understanding their comparative food value.

¹ Thesis presented for graduation, 1927, with the degree of Bachelor of Science in Agriculture from the College of Agriculture No. 264; Experiment Station contribution No. 538. Prepared in the Department of Agricultural Chemistry under the direction of Dr. F. O. Santos.

MATERIALS AND METHODS

The following are the materials analyzed. They were identified by Dr. Leopoldo Faustino of the Bureau of Science.

One species of oyster, talaba (*Ostrea orientalis* Chemnitz) was obtained from Malabon, Rizal; one species of crab, alimasag (unidentified), was bought in Calamba, Laguna; (*Palaemon sundaicus* Heller (Herre)) and (*Ampullaria vittata* Reeve) were secured in Los Baños, Laguna, and the rest in Unisan, Tayabas. Altogether, there were 28 species of shellfish used in this study. Owing to the remoteness of the sources of materials from the College, the effect of the strong typhoon on November 5, 1926 on the sources of supply, and the lack of laboratory facilities, relatively very few species were available for analysis.

Biña (*Melo aethiopica* Linn. Var. *Broderpii* Gray) is a salt-water-loving shellfish. It lives among rocks and corals in water at least a meter deep at low tide. The color varies from light to dark brown. Ordinarily it weighs about one kilogram. It is rarely found in the market because it is difficult to collect. Sometimes some are gathered and sold to Chinese who offer any reasonable price for them. Very few Filipinos eat this shellfish, probably because of its scarcity. The sample was obtained from Unisan, Tayabas.

Balakwit (*Strombus canarium* Linn.) is common in Manila and Tayabas bays. It was claimed by Seale (1912) that there are at least thirty species of the *Strombus* shells in the Philippines. Although the flesh is only ten per cent of the total weight of the organism, yet the animal is able to swim at the surface of the water. It is not uncommon to see a group of balakwits swimming along the coast of Tayabas Bay. It is a very good food. According to Seale (1912), it is sold in Manila at 6 centavos a kilogram. The specimen used in this investigation was collected in Unisan, Tayabas.

Patanang (*Murex ramosus* Linn.) is found in considerable quantities among reefs and rocks on shallow shores of Tayabas Bay. At first sight one would think that the shell would be difficult to handle, but upon close observation it is found that the spines are harmless. It has a black shell. It makes a good soup and sells at 8 centavos a kilogram. The sample used in this investigation was collected at Unisan, Tayabas.

Susóng dagat (*Cerithium vertagus* Linn.) has a very hard horny shell assuming a variety of color patterns on a white background. The season for collecting this shell is in August during very low tides. This crustacean loves deep water with a sandy bottom which is exposed only at this time of the year. It is found in Tayabas Bay. Owing to the seasonal appearance of this shell, it commands a high price. It sells at 15 centavos a kilogram. The sample was obtained from Unisan, Tayabas.

Talitap-ong (*Murex capucinus* Lk.) is plentiful in marshes under mangrove trees (*Rhizophora* spp.). They can be collected from muddy brooks in which the water is brackish. Decaying logs submerged in water

harbor many of these shellfish. It is interesting to note that they can live out of their natural habitat for at least a week. The writer succeeded in keeping his extra specimens alive for ten days in the laboratory in a basket woven out of fresh leaves of buri (*Corpyha alata* Roxb.). At the end of this time some were thrown away while yet alive. Probably, they would live still longer. Many tenants in the coconut regions bordering marshy patches collect these shellfish on Sundays and holidays. They form an important part of the diet of the laboring class in these localities. They sell at 7 centavos a kilogram. This sample came from Unisan, Tayabas.

Cohol (*Ampullaris vittata* Reeve) is found in abundance in Laguna de Bay; it is also found in fresh water ponds, creeks, and rice paddies. It approaches the shape of a Venus clam. It has a thin green shell. It is of little importance as food except in some places as Lucban, Tayabas, where it is collected from rice paddies and eaten cooked. It is more commonly used as a poultry feed than as a food. It sells at 5 centavos a hundred around Laguna de Bay. The sample analyzed was collected at Los Baños, Laguna.

Taktakin (unidentified), (plate 1; fig. c) is very common along the coast of Tayabas Bay in shallow water with rocky bottom. It has a conical shell with blunt apex and hemispherical operculum. It measures ordinarily three centimeters on the longest diameter at the longest diameter of the operculum. It makes a delicious soup. It sells at 10 centavos a kilogram. It is plentiful along the shores of Tayabas Bay in Unisan, Tayabas, where the material used in this study was collected.

Bitubituin (unidentified), (plate 1; fig. e), is a Venus clam. It has a white shell and yellow flat operculum. It measures two centimeters on the operculum. It is found in large quantities on sandy beaches submerged at high tide. It is highly regarded as a food and sells at 7 centavos a kilogram in Unisan, Tayabas, where the sample was collected.

Tibangca (*Nerita*) is found clinging on stones in brackish water along river banks which are submerged at high tide. It is green and the shell when treated with a weak acid (acetic) reveals a variety of nice colorations. In regions where this shell is abundant it is usually considered a good diet for people who are sick. This shell sells at 6 centavos a kilogram in Unisan, Tayabas, where the sample was obtained.

Susóng tabang (unidentified), (plate 1; fig. b), is a fresh water black horn shell. It is plentiful in shallow water of creeks and ponds. It is regarded as a good food. It combines well with a species of edible fern, paco (*Pteris quadriaurita*) and coconut milk. It is very popular among poultry raisers, particularly duck raisers, because it provides both feed and grit. It sells at 6 centavos a kilogram. The sample studied came from Unisan, Tayabas.

Caligay (unidentified), (plate 1; fig. g), is found in abundance along the coast of Tayabas Bay in shallow water with sandy bottom. It is collected

by raking on the sand with the fingers at low tide. As it is small it takes time to separate the flesh from the shell. For this reason in Manila and probably in other places it is eaten more between meals than at meal time. The Manilan sits down with a plate of boiled caligay and patiently draws one by one the snails from the shell with the aid of a pin. It sells at 7 centavos a kilogram.

Tapalang (*Cyrena gigantea* Prime) is found living in the mud at a depth of about 5 centimeters along the banks of rivers and brooks with brackish water. This is one of the large clams. It is black and measures, ordinarily, about 10 centimeters on its longest diameter. It is collected by scratching the mud with a dull bolo; the chances are, if it is plentiful, that any hard object that the bolo encounters is tapalang. It makes an excellent soup. Besides being used as food, the shell is used as a source of lime for the sugar industry and to mix with *buyo*. It sells at 8 centavos a dozen. The material was obtained in Unisan, Tayabas.

Barong (*Pinna virtaga* Menke) abounds on sandy shores exposed at low tide. The pointed end of the shell is buried while the broad flat end barely reaches the surface of the sand. Walking barefooted, except with care, on places where they are abundant is not safe. The broad end is sharp and can make a deep cut on the foot, if stepped on. A specimen measuring 50 centimeters long is not unusual. The Bureau of Science (Mining Division) has a fossil of this shell which measures about 40 centimeters in length. People along the coast of Tayabas Bay know how to prepare a very palatable dish out of this shellfish. It sells at 10 centavos a kilogram.

Manlit (*Tridacna cumingii* Reeve) is found among rocks and reefs in salt water. They vary in size, weighing from several hundred grams to 30 kilograms. Fossils of large specimens may be seen where holy water is placed near the doors of the old churches in some towns of Tayabas. Collecting these shellfish is rather risky. They are located in deep water and are secured only by diving. Besides the danger from attack by sharks, there is also danger in handling the shells. The shell is attached firmly to a piece of rock and the valves are oftentimes open ready for the prey that may come along; when disturbed the shells immediately close and remain so until the prey is digested. But, when a person dives and accidentally puts his leg or hand between the valves, instantly he will be cut, the seriousness of which will depend upon the strength and sharpness of the edges of the valves. The gripping is not due to aggressiveness on the part of the animal but to its fright when disturbed by large objects. Very few people eat manlit, owing probably to the difficulty involved in getting it and the coarseness and the toughness of the flesh. The shells are gathered for decorating purposes. This shellfish is rarely found in the markets.

Talaba (*Ostrea orientalis* Chemnitz) is found in practically every island in the Philippines. It is an important source of food among Filipinos; so

important that it is cultivated in Malabon and in other tide flats of Manila Bay. Seale (1912) reports that private claims on oyster beds are watched by hired watchmen to prevent thieving. Along the banks of rivers flowing into Tayabas Bay these oysters are also found. In Manila they sell at 20 to 50 centavos a liter (shelled) (Seale (1912)). The sample used in this study was from Malabon.

Capios (unidentified), (plate 1; fig. i), is found living in clusters attached to the roots of mangroves. A portion of a root 50 centimeters long may harbor as many as 200 individuals. The sparse population in Tayabas is the probable reason for this oyster's being neglected. It offers a wholesome food, whether eaten raw or cooked. It makes an excellent chowder. It sells at 3 centavos a kilogram. The sample was collected in Unisan, Tayabas.

Litog (*Arca granosa* Linn.) has practically the same qualities as bigatan, requiring the same habitat.

Bebe (unidentified), (plate 1; fig. d), is found in black sand in fresh water rivers. It varies a great deal in size ranging from a few centimeters to ten centimeters along the greatest diameter. The shells vary in color from dark green to black. They are collected by sifting the sand. They make an excellent soup (Seale, 1912). In Manila they sell for 7 centavos a kilogram.

Tihim (*Tellina incerta* Deshayes (?)) lives in the same environment as the bebe. In fact, they are collected at the same time bebe is. The tihim has a green shell and the inside part turns violet when cooked. In Tayabas a kilogram of tihim sells for 20 centavos.

The camotpusa (*Circe gibba* Lk.) is abundant on the sand bars and sandy beaches of Tayabas Bay. It is also found along the beaches of Manila Bay. The shell has ridges radiating from the posterior to the anterior portion. Black streaks across the hinge are on a white background (Seale, 1912). It makes a very delicious soup. It sells at 6 centavos a kilogram in Manila.

Punao (*Tapes striatus* Chemnitz) is one of the highest priced clams. Ordinarily, it is light brown with low ridges running parallel to the margin of the shell. It is collected by scratching the sand with a dull bolo when the beach is exposed, or by watching for a characteristic upward current visible at the surface of the shallow water, and at once digging below it; here the clam is located.

Collecting this particular clam has become a sort of sport among Manila college girls who spend vacations in Unisan, Tayabas and other coast towns. During low tides boys and girls collect punao. The personal experience of the writer is that it is not the catch that counts but the fun of gathering the clams.

This clam sells at 20 centavos a kilogram.

Fresh water shrimp (*Palaemon sundaicus* Heller (Herre)) lives under vegetable debris in fresh water. People around Laguna de Bay have acquired a certain dexterity in catching groups of them. They stick bundles of twigs into the mud under water with long bamboo poles. After a certain length of time, they raise these bundles and pass nets under them thus catching the shrimps that had taken up their abode on the artificial shelters. In appearance there is not very much difference between fresh and salt water shrimp. Close study, however, will reveal that the fresh water shrimp has a shorter cephalothorax and abdomen but larger and longer pinchers than the salt water. Both are highly regarded as food. Fresh water shrimps around Laguna de Bay sell at about 25 centavos a kilogram. The sample was obtained from Los Baños, Laguna.

Salt water shrimp (*Penaeus* sp. (Herre)) is found in brooks and at the mouth of rivers flowing into Tayabas Bay. A comparison of salt water with fresh water shrimps is given in the preceding paragraph. Salt water shrimps are caught with nets or with lights and portable traps on dark nights. In the Lucena, Tayabas, market, a specimen measuring 15 centimeters long will sell for 3 centavos. The material used in this study was caught in Unisan, Tayabas.

Alimasag (unidentified), (plate 1; fig. f), is found along the coast of Tayabas Bay in shallow water with sandy or rocky bottom. When fresh, the chitinous covering is green with curious brown markings all over the dorsal part of the cephalothorax and the appendages. The ventral side is white. All the chitinous covering turns red when cooked. Alimasag vary in size from four centimeters to 20 centimeters at the longest axis of the cephalothorax. When chased, they bury themselves in the sand, their backs just appearing on the surface. They can then be caught by grasping the posterior side with the hand. Held in this way they are harmless as they cannot reach the hand with their powerful pinchers. Portable traps with the aid of lights are used also on dark nights. These crustaceans command high prices because of their palatability. Those of good size will sell at 50 centavos for two or three in Calamba, Laguna, where it is imported and sold.

Alimaño (unidentified), (plate 1; fig. h), is a species found in salt water living in holes among the rocks. This crustacean is caught in the same way as the alimasag. It is black when fresh but turns red when cooked. There are several varieties of this species in the rivers and marshes. They are a table delicacy. They sell ordinarily at 50 centavos for three in Unisan, Tayabas, where the specimen came from.

Pusit (unidentified), (plate 1; fig. a), is caught on moonlit nights in fish traps with the aid of fish nets. It is popularly believed by fishermen that this squid goes ashore during bright nights in quest of food. It is soft-bodied and provided with tentacles. Its means of protection is only a bag of ink. When an enemy is in sight it secretes a small amount of ink which

it shoots instantly posteriorly. This secretion is enough to blur the surrounding water so it can escape. This squid is a very good food. When fresh, 5 centavos will purchase a piece 20 centimeters long. They are sold fresh and dried.

The kind shown in plate 1 is good for making *pansit*. This dish is very popular in Chinese restaurants. The material examined in this investigation was obtained in Unisan, Tayabas.

EXPERIMENTS AND RESULTS

Sampling

Only the edible portion containing both flesh and liquid was analyzed for organic constituents. The sample was ground in a meat grinder. The liquid and shredded flesh were collected and stirred to obtain as far as possible a homogeneous mixture. Then representative portions were used for analysis. Six samples were used for each determination made.

Experimental procedure

The methods used by the Association of Agricultural Chemists (1919) and those compiled by the Illinois Agricultural Experiment Station (1920) were employed in this investigation.

Moisture. The loss in weight of about 5 grams of the materials dried to a constant weight at 100°C. divided by the weight of the sample multiplied by 100 gave the percentage of moisture.

Ash. The sample used in the determination of moisture was used in determining the percentage of ash. The dried material was charred and ignited to a low redness. The increase in weight of the crucible gave the amount of ash. The weight of ash divided by the weight of sample times 100 gave the percentage of ash.

Fats. A weighed fresh sample was placed in a fat-free thimble and dried to a constant weight at 100°C. It was then placed in a Soxhlet extractor for three successive days for about eighteen hours. A longer time was found to be unnecessary. The loss in weight of the dried material divided by the fresh weight of the fresh sample multiplied by 100 gave the percentage of fats.

Proteins. The ordinary Kjeldahl method of determining nitrogen was employed. The percentage of nitrogen multiplied by 6.25 was considered the percentage of proteins in the sample.

Carbohydrates. Carbohydrates were determined by difference. After subtracting from 100 per cent the sum of the percentages of moisture, ash, fats, and proteins, the undetermined remainder was attributed to carbohydrates.

Calorific value. The calorific value per hundred grams was obtained by multiplying the percentage of fat by 9.3 and the percentage of proteins and carbohydrates by 4.1. The sum of the three products was taken to represent the calorific value of the material.

Total nutrients. The sum of the percentages of fats, proteins, ash and carbohydrates was considered to represent the total nutrients.

Nutritive ratio. Nutritive ratio was obtained by dividing the percentage of carbohydrates plus the percentage of fats multiplied by 2.25 by the percentage of proteins.

DISCUSSION OF RESULTS

Table 1 shows that about 40 per cent by weight represents the edible portion of the mollusks and crustaceans studied in this experiment. This portion, in turn, contains 80 per cent moisture.

Taktakin (unidentified), salt water shrimp (*Penaeus* sp. (Herre)), pusit (unidentified), balakwit (*Strombus canarium* Linn.), and talitapong (*Murax capucipus* Lk.), all salt water species of shellfish, have a high caloric value. By comparing salt and fresh water shrimps, one will find that the former has a higher food value than the latter. Usually, salt water species of shellfish have a high percentage of proteins, fats, and ash, while fresh water species are higher in carbohydrates.

Of all the species examined, pusit gives the highest in edible portion. It has also a relatively high percentage of proteins. This shows that there is very little waste in the weight of the material bought so that it is reasonable to pay a higher price for it than for other kinds.

Table 1 shows that the analyses by Atwater and Brynt, Bacol, and by the writer agree fairly well. The difference in the protein content of lobster as determined by Atwater and Brynt (16.4 per cent) and by the writer (21.2 per cent) may be explained by the difference in the stage of development of a lobster.

In this table it is shown that 20 per cent of the edible portion on the wet basis of Philippine shellfish represents the total nutrients.

The nutritive ratio in balakwit (*Strombus canarium* Linn.), 1:4 is the highest. This is considered a narrow ratio. It means that out of the total digestible protein in Philippine shellfish there is at most 25 per cent carbohydrates and fats combined.

SUMMARY OF CONCLUSIONS

(Philippine shellfish analyzed)

1. Philippine shellfish contain about 40 per cent edible portion and the remaining 60 per cent represents shell or chitinous skeleton.

2. The protein content ranges from 4 to 20 per cent.

High in proteins (over 10 per cent of the edible portion on the wet basis) are: Alimasag (unidentified); Barong (*Pinna virgata* Menke); bigatan (*Arca granosa* Linn.); halang (*Fasciolaria trapezium* Linn.); litog (*Arca granosa* Linn.); manlit (*Tridacna cumingii* Reeve.); patanang (*Murex ramosus* Linn.); pusit (unidentified); salt water shrimp (*Penacus* sp. (Herre)); susong tabang (unidentified); taktakin (unidentified).

3. The percentage of fats ranges from 0.5 to 3.5 per cent. High in fats (over 20 per cent) are: alimaño (unidentified); alimasag (unidentified); bebe (unidentified); bigatan (*Arca granosa* Linn.); biña (*Melo aethiopica* Linn. Var. *Broderipii* Gray); punao (*Tapes striatus* Chemnitz); salt water shrimp (*Penaeus* sp. (Herre)); taktakin (unidentified); talaba (*Ostrea orientalis* Chemnitz); tibangca (*Nerita*); tihim (*Tellina incerta* Deshayes (?)).

4. The ash varies from 0.5 to 4.5 per cent. In some, ash sand is found in the ignited material. Probably, it was held as grit in the alimentary tract of the shellfish. High in ash (over 4 per cent) are: balakwit (*Strombus canarium* Linn.); bitubituin (unidentified); caligay (unidentified); cohol (*Ampullaria vittata* Reeve); susong dagat (*Cerithium vertagus* Linn.); susong tabang (unidentified); talaba (*Ostrea orientalis* Chemnitz).

5. The undetermined portion attributed to carbohydrates is around 6 per cent. Usually, shellfish are a wholesome food either raw (for some species) or cooked.

High in carbohydrates (over 10 per cent) are: balakwit (*Strombus canarium* Linn.); bebe (unidentified); bitubituin (unidentified); caligay (unidentified); fresh water shrimp (*Palaemon sundaicus* Heller (Herre)); pusit (unidentified); talitapong (*Ranella vittata* Reeve).

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TABLE 1
Comparative composition of Philippine shellfish

NAME OF SAMPLE ^a	REFUSE	EDIBLE PORTION	MEAT INCLUDING LIQUID				TOTAL NUTRIENTS	CALORIFIC VALUE PER 100 GRAMS	NUTRITIVE RATIO 1 TO
	Shell	Meat and liquid	Moisture	Fats	Proteins	Ash	Undetermined (Carbohydrates)		
	per cent	per cent	per cent	per cent	per cent	per cent	per cent	per cent	per cent
Alimaño, (unidentified).....	42.12	57.88	84.49	2.55	7.40	1.89	3.67	15.51	1.27
Almasag, (unidentified).....	42.98	57.02	81.29	2.38	13.12	2.80	0.41	18.71	0.44
Balakwit, <i>Strombus canarium</i> Linn.....	89.02	10.98	72.46	1.55	4.78	5.16	16.05	27.54	4.09
Barong, <i>Pinna virgata</i> Menke.....	60.58	39.42	80.89	0.77	11.32	3.92	3.10	19.11	0.43
Bebe, (unidentified).....	55.30	44.70	78.14	2.29	7.58	0.55	11.44	21.86	2.19
Bigatan, <i>Area granosa</i> Linn.....	78.02	31.98	79.61	3.24	13.00	1.37	2.79	20.39	0.78
Biña, <i>Melo aethiopica</i> Linn. Var. <i>Bruderipii</i> Gray.....	28.97	71.03	80.15	2.42	8.75	1.67	7.01	19.85	1.43
Bitubutun, (unidentified).....	61.36	38.64	73.20	0.38	9.21	4.55	12.66	26.80	1.47
Caligay, (unidentified).....	60.01	39.99	77.86	0.62	4.21	4.23	13.08	22.14	3.44
Canutputsa, <i>Circe gibba</i> Lk.....	81.92	18.08	85.79	0.85	5.43	2.43	5.50	14.21	1.36
Capios, (unidentified).....	87.28	12.72	87.60	0.35	7.67	2.67	1.71	12.40	0.33
Cohol, <i>Ampullaria vittata</i> Reeve.....	39.69	60.31	80.43	1.87	8.00	4.10	5.61	19.57	1.23
Fresh water shrimp, <i>Palaeomon sundaeus</i> Heller (Herre).....	39.65	60.35	77.91	0.33	8.26	2.31	11.09	22.09	1.46
Halang, <i>Fasciolaria trapezium</i> Linn.....	66.30	33.70	76.14	1.43	13.48	2.08	6.87	23.86	0.75
Litog, <i>Area granosa</i> Linn.....	77.05	32.95	80.51	0.58	10.66	1.37	7.86	19.49	0.86
Manlit, <i>Tridacna cumingii</i> Reeve.....	88.72	11.28	80.06	0.52	11.91	2.77	2.81	19.44	0.33
Patanang, <i>Murex ramosus</i> Linn.....	77.54	22.46	79.58	0.77	17.07	1.87	0.71	20.42	0.14
Pumao, <i>Tapes striatus</i> Chemnitz.....	64.29	35.71	84.23	2.34	6.16	1.70	5.57	15.77	1.76
Pusit, (unidentified).....	2.44	97.56	74.19	0.53	11.84	2.37	11.07	25.81	1.04
Salt water shrimp, <i>Penaeus</i> sp. (Herre).....	37.42	62.58	72.03	3.53	21.18	2.55	0.71	27.97	0.41
Susóng dagat, <i>Cerithium verlagus</i> Linn.....	79.64	20.36	80.42	0.61	8.47	6.80	3.70	19.58	0.60
Susóng tabang, (unidentified).....	70.95	29.05	79.23	0.83	10.81	4.62	4.51	20.77	0.59
Taktakin, (unidentified).....	66.01	33.99	79.33	2.14	15.48	2.64	0.41	20.67	0.34
Talaba, <i>Ostrea orientalis</i> Chemnitz.....	82.10	17.90	83.11	2.62	7.05	4.64	2.58	16.89	1.20
Talitapong, <i>Murex capucinus</i> Lk.....	67.73	32.27	73.54	0.56	8.53	2.50	14.87	26.46	1.88
Tapalang, <i>Cyrena gigantea</i> Prime.....	35.01	64.99	85.04	0.42	8.63	1.96	3.97	14.96	0.57
Tibangca, <i>Nerita</i>	62.51	37.49	84.40	2.12	6.42	1.80	5.26	15.60	1.56
Tihim, <i>Tellina incerta</i> Deshayes (?).....	77.78	22.22	86.42	2.18	4.24	1.49	5.67	13.58	2.50
Average.....	61.80	39.91	79.89	1.46	9.67	2.82	6.09	20.07	1.27

^a All local names are given in Tagalog dialect.

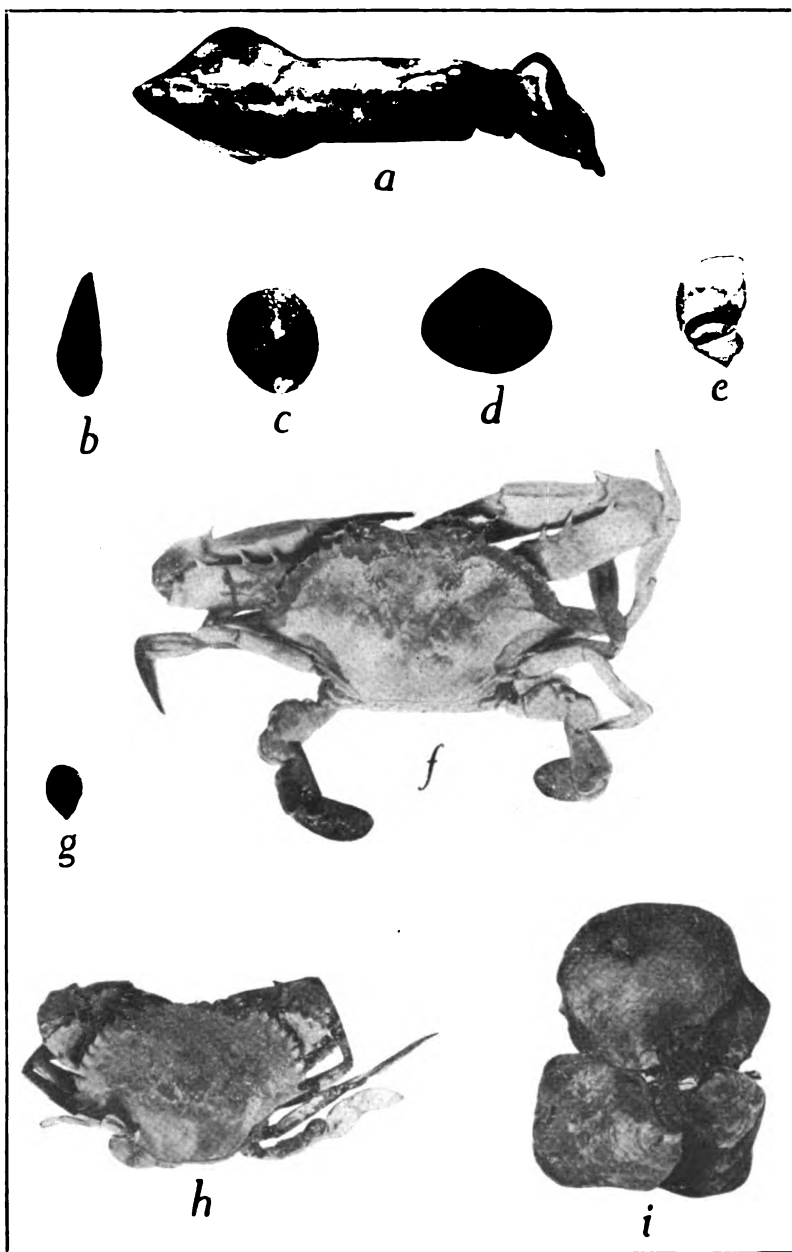


PLATE I

Fig. *a*.-pusit; *b*.-susong tabang; *c*.-taktakin; *d*.-bebe; *e*.-bitubituin; *f*.-alimasag; *g*.-caligay; *h*.-alimaño; and *i*.-capios.

THE CULTURE AND COST OF PRODUCTION OF BARIT IN BAY. LAGUNA¹

RAMÓN C. ORDOVEZA

WITH FOUR TEXT FIGURES

Barit, or zacate (*Leersia hexandra* Sw.) is extensively cultivated in the Philippines, particularly around the city of Manila and in the neighboring provinces. It is used as a soiling for horses to take the place of the dry feeds, as hay and silage do in temperate countries. The daily ration of Philippine horses consists principally of barit soiling.

The provinces of Rizal, Laguna, Cavite, and Bulacan supply the daily demand for this soiling in Manila. In the province of Laguna, the town of Bay is one of the oldest and largest producers of this crop. This fact, together with the growing importance of the barit industry, induced the writer to carry out this investigation.

Although barit is so important as a feed for horses in the Islands, there has been, heretofore, no work on its culture published. It is, however, mentioned by Galang and Paulino (1925) and by Piper (1924)² as a forage grass extensively cultivated in the Philippines.

It was the purpose of this work to study the culture of barit in the town of Bay. The study included experiments on fertilization and on weeding. This report also presents data on the cost of production to show the average income of a barit farmer.

This study was carried out in some of the plantations in Bay from October 1926 to December 1927. In addition, data on production from 1922 up to 1925 are included. The experiments here reported were carried out in the Ordoveza barit plantation.

CULTURE

It was the growing demand for barit in Manila which began about 1920 that aroused the interest of farmers in this forage plant in some nearby localities with good transportation facilities to the capital. The farmers in Bay were not getting much profit out of their rice lands, so most of them

¹ Thesis presented for graduation, 1928, with the degree of Bachelor of Agriculture from the College of Agriculture No. 265; Experiment Station contribution No. 539. Prepared in the Department of Agronomy under the direction of Dr. Toribio Vibar.

² Galang, F. G., and P. L. Paulino. 1925. A progress report on forage crop investigations at the Lamao Experiment Station, Lamao, Bataan. The Philippine Agricultural Review 8: 3-31.

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transformed their rice fields into barit plantations. The area devoted to this forage plant in Bay has increased considerably since 1921.

Site for a barit plantation

One of the important points to be considered in selecting a site for a barit plantation is the facility for transportation from the field to the market. This point is important because barit will not remain fresh for more than two days, and if wilted it is useless for feeding purposes. In Bay, most of the barit fields are located near the railroad station.

Generally, soils adapted to the culture of lowland rice are suitable for the growing of barit. In Bay, such soils are of the clay loam type; they are watered by a good irrigation system.

Preparation of the field

The preparation of the land is similar to that for lowland rice. The field is divided into paddies with well constructed dikes. It is kept under water and plowed with the native plow. Two plowings are necessary, each followed by thorough harrowing with the native harrow called *suyod*. After



Fig. 1.—A paddy plowed under wet conditions.

the first harrowing, the field is kept under water until the weeds have decayed; then, it is harrowed again. By the second harrowing the field is made smooth and even, and is then ready for planting.

The field is generally prepared during the rainy season when there is plenty of water, and also barit cuttings for planting purposes.

Planting

Before planting, the paddies are flooded to about two to five centimeters deep. The materials for planting are the shoots or the same portions of the plant that are fed to horses. The old shoots that are too tough to be

used as feed may also be used, but they do not give as high a percentage of growth as the medium ones. The shoots, or cuttings, are laid uniformly on the water and then pressed down so that they settle in the mud. (See fig. 2.) The thickness of planting depends upon the amount of seedlings available. Some farmers claim that the thicker the planting, the better

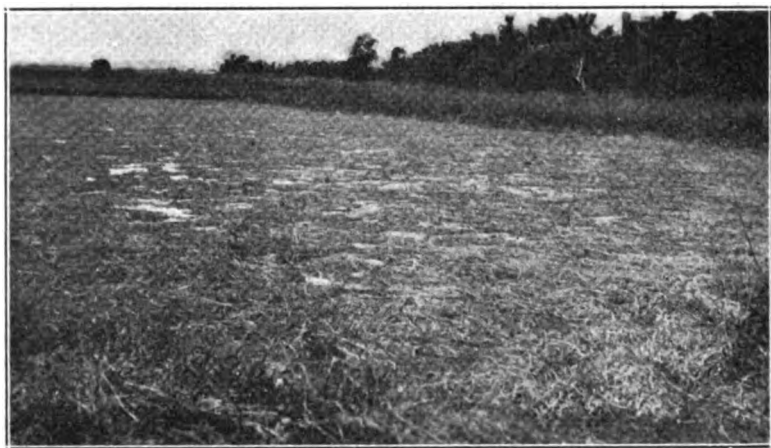


Fig. 2.—A newly planted paddy.



Fig. 3.—A paddy one week after planting. Note sprouts shooting up.

the result, because there will be less chance for the weeds to grow. About 200 bales to the hectare is the usual rate of planting. After planting, the field is kept flooded until the sprouts begin to come out. When this stage is reached the field is drained but kept moist. When the shoots attain a height of about seven centimeters (three inches), the field is again flooded to a depth of about three centimeters; this depth is maintained until the plants reach maturity.

Cutting or harvesting

The first cutting is done about one or two months after planting; the time depends upon the climatic conditions. The barit is cut when it is about thirty-five centimeters in height. Lodging is an indication of over-maturity. The barit from Bay is usually shipped to Manila on a noon train, hence, cutting is generally done late in the afternoon and early the following morning so the grass will be fresh. A form of native sickle is used for cutting. A big handful is cut and then tied in a bundle with a few blades of barit. One hundred of these bundles are tied together and constitute one bale. The size of the bale is not uniform throughout the year. When the price of barit is high it is smaller than when the price is low. This variation is because the bale is the unit of measure in the market.

All the barit produced by a farmer is usually under contract by one or more buyers in Manila. Generally, there is a fixed number of bales sent to the buyer every day. Since barit is shipped to Manila by rail, each farm has its own mark on each bale so that the buyer can identify the product from different farms. Some farmers use banana leaves inserted in each end of the bale for the mark, while others use papaya leaves.

From the Ordoveza farm, data on production of barit of a ten-paddy lot from 1922 to 1925, inclusive, were secured and are presented in table 1. The field was planted on December 1, 1921, and the first cutting was made on February 1, 1922. It will be seen in table 1 that from 1923 to 1925 there were paddies without production during certain months of cropping. This was because of the great variability in the growth and maturity of the plants in the different paddies. The unevenness in growth and in maturity of the plants was more pronounced as the fields or plantations became older. The total production of the ten paddies under study during 1922, 1923, 1924,

TABLE 1
Showing longevity of a barit field
1922 production

DATE CUT	AREA IN SQUARE METERS										TOTAL
	689	693	633	679	625	637	641	642	670	679	6628
	<i>bales</i>	<i>bales</i>	<i>bales</i>	<i>bales</i>	<i>bales</i>	<i>bales</i>	<i>bales</i>	<i>bales</i>	<i>bales</i>	<i>bales</i>	
February...	46	40	40	44	45	37	42	44	52	45	435
April.....	37	20	22	32	33	27	25	35	25	36	292
June.....	56	50	50	50	40	44	30	40	38	40	438
July.....	34	18	18	24	24	18	17	18	36	22	229
August....	25	24	17	27	22	24	8	26	25	22	220
October....	14	28	25	16	14	30	25	22	30	14	218
November..	22	15	16	27	21	20	22	27	24	26	220
December..	—	—	14	12	23	19	18	24	20	25	155
											2207

<i>1923 production</i>										
January...	14	14	—	8	4	—	—	—	—	40
March....	21	21	30	23	27	27	22	24	22	244
April.....	—	—	—	18	—	—	—	25	—	64
May.....	24	5	15	6	19	20	19	—	20	128
July.....	19	3	12	22	16	16	20	18	20	168
August....	10	17	11	15	15	14	15	16	16	149
September..	22	8	27	24	21	17	18	18	20	193
October....	—	14	14	—	23	20	25	26	24	174
November..	20	—	—	24	—	—	—	—	—	44
December..	26	22	25	24	21	28	28	36	27	265
										1469
<i>1924 production</i>										
January...	14	—	16	26	17	23	20	26	22	174
February...	21	21	23	—	—	—	—	—	—	65
March....	—	—	—	21	—	22	33	25	21	144
April.....	—	—	—	—	—	—	21	—	—	23
May.....	32	21	31	24	22	—	—	—	—	146
June.....	15	—	—	—	30	—	55	—	60	168
July.....	22	16	—	52	38	20	32	7	33	262
August....	20	10	16	12	10	—	16	20	—	104
September..	—	—	—	—	—	20	14	24	6	64
October....	22	22	23	20	12	36	8	30	20	211
November..	14	—	—	10	10	10	10	10	10	86
December..	—	10	18	—	22	—	—	14	18	82
										1529
<i>1925 production</i>										
January...	6	12	6	14	8	10	12	12	12	92
February...	20	14	14	6	—	10	8	8	6	112
March....	—	—	—	—	—	—	—	—	8	8
April.....	—	—	—	—	6	—	—	—	—	6
May.....	—	—	—	4	—	—	—	—	—	4
June.....	24	34	28	—	34	34	—	—	—	154
July.....	14	20	12	16	26	20	24	22	20	196
August....	—	—	20	10	—	18	10	—	10	68
December..	14	10	12	12	10	14	8	12	4	8
										744

and 1925 were 2207, 1469, 1529, and 744 bales, respectively. The field was no longer productive after the fourth year. The average life of a barit field in Bay is four years while around Manila where farming is more intensive, the barit plantations are renewed every one or two years.

The number of cuttings made in a year on this ten-paddy field was about seven, and the intervals between these cuttings varied with the season. Cuttings were more frequent during the rainy than during the dry months. It may be noted in table 1 that in some cases some paddies produced no grass for as long as four months. The reason was that the grass harvested was sometimes too weedy to be sent to Manila. So the practice of the *zacatero*, the man who cuts and bales the grass, was to cut

the grass but not to bale it. This grass was either piled on the dikes or thrown away. In such cases no record was made.

Weeding

Among the problems of the barit farmer the weed question is the most important. There are many weeds in the barit field. The gume (*Fimbristylis miliaceae* (Linn.) Vahl.), and kumot palaka (*Panicum* sp.) are common among the weeds which crowd out the plants and finally kill them. If a newly planted field is left unweeded, it may not last for more than a year, but if properly taken care of it may last for even five years. A newly planted field has very few weeds, they become numerous as it becomes old.

If cheap labor is available, hand weeding is the best method of eradicating these weeds. This is the procedure in the fields around Manila where women are employed to pull up the weeds.



Fig. 4.—The *latak* in operation. Note the condition of the barit.

In Bay a *caminero*, the man who attends to the weeding and care of the plantation, has a larger area, comparatively, to take care of, hence, he can not clean the plantation by hand weeding alone. So he resorts to other methods, one of which is the use of the *latak* (see fig.4). This implement is similar in construction to a roller, except that its surface is serrated. It is pulled by a carabao and is run over a weedy paddy until the grass lies flat on the ground. When the paddy is subjected to this treatment the weeds generally do not have the power to grow again, but the barit can still produce shoots.

Table 2 presents the result of an experiment on the effect of this implement on the production of barit. The paddies in which this implement was rolled were old and weedy. The *latak* was run over them one month after the December cutting in 1926. It will be seen in table 2 that the average

production of the ten paddies in December 1926, just before they were treated with the *latak*, was 377 bales to the hectare, while in February, April, and June, after they had been treated with the *latak* the corresponding average yields were 569, 387, and 286 bales to the hectare. This shows that there

TABLE 2
Effect of the latak on the yield of barit
(1926-1927)

LOT NO.	NOVEMBER (NO LATAK)	DECEMBER (NO LATAK)	FEBRUARY	APRIL	JUNE
	bales per hectare	bales per hectare	bales per hectare	bales per hectare	bales per hectare
1	460	400	630	230	310
2	490	460	580	270	260
3	500	470	570	570	310
4	480	410	640	390	320
5	510	390	580	360	280
6	330	270	410	330	220
7	540	480	660	510	380
8	480	310	610	380	210
9	430	310	520	480	360
10	390	270	490	350	210
Average	461	377	569	387	286
Check	450	340	210	90	—

NOTE:—*Latak* was used one month after December cutting.
Hence, the November and December cuttings were
before the *latak* was used.

was a sudden increase in the cutting after the *latak* was used, then, a gradual decrease followed. The plot which was not treated by the *latak* showed a steady decrease in yield; the yields to the hectare for December, February, and April being 340, 210, and 90 bales, respectively. The control had another disadvantage in that the weeds in the barit made cutting more difficult, hence, more expensive, because the *zacatero* had to remove the weeds from each bunch. Buyers reject weedy barit. It may be seen from this experiment that the use of the *latak* in weedy barit fields is advantageous, for it not only increased the yield, but also lengthened the life of the plantation.

Proper irrigation may control the weeds to a certain extent. It is a common experience that weeds, especially the *gume*, are more prevalent during the dry season. The control of the water level in the culture of barit is so important that it deserves special attention. The general practice in Bay is to keep the field just moist after cutting. Then as soon as the stubs have produced sprouts, the water level is increased gradually to a depth of about three centimeters. If the field is irrigated immediately after cutting most of the shoots will decay. On the other hand, if it is not irrigated at all, some kinds of weeds which flourish in dry soil will become so prevalent as to cause considerable injury to the crop. Hence, the best practice is, moist field after cutting; after sprouting, gradually increase water to three centimeters in depth.

Fertilization

As stated in first part of this paper, the cultivation of barit in Bay was begun about seven years ago. In this period most of the barit plantations have been replanted but once. In table 2 it may be seen that as the field grew older the yield decreased. This decrease in yield may have been the effect of noxious weeds which killed some of the plants, or may have been caused by soil exhaustion, or it may have been the result of both.

An experiment on the effect of fertilizers on old barit plantations was conducted on the Ordoveza farm. The paddies used in this experiment were about three years old and were already giving poor yields. The fertilizers were applied one week after the September cutting in 1926. Washing off of the fertilizers from one paddy to another was prevented by having good control of the irrigation water.

Hoz with a formula of 13-6-2 was used as the standard fertilizer. This was applied at the rate of 200 kilograms to the hectare. The other fertilizers, ensac, ammo-phos, complete, guano, and copra meal were applied in amounts so that the total nitrogen of each was the same as that supplied by 200 kilograms of hoz (standard). Lime was applied at the rate of 200 kilograms to the hectare.

The experiment was carried in triplicate plots, the main object of which was to minimize as much as possible the error due to soil variability. The size of the bales produced from the different paddies fertilized was made as uniform as possible so that comparison of the yields would be more accurate.

Table 3 gives the average production of the fertilizer experiments, computed in terms of bales to the hectare. As may be seen in this table, ammo-phos, hoz, and complete fertilizers gave significant increases in yield in the November cutting, about one month after the application of the fertilizers. Guano gave a slight increase, while copra meal, ensac, and lime decreased yield as was the case of the control. The high production

TABLE 3
Effect of commercial fertilizers on the yield of barit
(1926-1927)

FERTILIZERS	SEPTEMBER (NOT FERTILIZED)	NOVEMBER	DECEMBER	FEBRUARY	APRIL	JUNE
	<i>bales per hectare</i>	<i>bales per hectare</i>	<i>bales per hectare</i>	<i>bales per hectare</i>	<i>bales per hectare</i>	<i>bales per hectare</i>
Ammo-phos.....	430	1280	850	410	250	211
Hoz.....	230	430	430	200	181	40
Complete.....	230	360	270	190	50	20
Guano.....	410	420	330	220	190	—
Copra meal.....	450	410	370	390	200	—
Ensac.....	320	320	200	170	—	—
Lime.....	640	586	404	320	—	—
Check.....	450	400	340	260	—	—

NOTE:—All the lots were fertilized after September cutting except the check. Hence, the September cutting was before fertilization.

of the paddies treated with ammo-phos, hoz, and complete fertilizers was not, however, maintained beyond the second cropping after the application of the fertilizers. In the subsequent cuttings, the yields gradually declined. The fertilizers that gave the highest increase in yield have a good combination of nitrogen and phosphorus (see table 4). Barit did not react favorably with ensac which is supposed to contain as much as 17 per cent nitrogen. This unfavorable result is probably due to the fact that it has no phosphorus. Lime had no effect on the growth and production of barit.

TABLE 4
Analysis and source of fertilizers used

FERTILIZER	ANALYSIS			SOURCE
	N	P	K	
	per cent	per cent	per cent	
Ensac.....	17	0	0	Botica Boie
Ammo-phos..	17	20	0	Botica Boie
Hoz.....	13	6	2	Menzi & Company
Complete....	10	6	2	Menzi & Company
Guano.....	12	4	2	College of Agriculture
Copra meal..	8	3	2	Philippine Refining Corporation
Lime.....	—	—	—	College of Agriculture

COST OF PRODUCTION OF BARIT

In considering barit as a crop, the income of a farmer engaged in its production is important. Data along this line were gathered from farmers actually engaged in the industry. It might be stated that about five or six years ago when barit was not yet extensively cultivated in Bay the income from a hectare of land was comparatively high in spite of the high cost of production. This was because of the great demand for barit and the limited supply of the crop. The price per bale of barit in that period rose as high as ₱0.50, about twice what it is at present. It was this high price that induced farmers to grow barit until the competition has become so keen that the price of the forage has fallen considerably.

The figures given below are averages of the cost of production on four barit farms in Bay, Laguna. These records are for the year 1927. The expenses in starting a hectare of barit plantation are:

Preparation of the land.....	₱80.00
Cost of seedlings (200 bales at ₱0.24).....	48.00
Cost of planting.....	20.00
Total initial cost.....	₱148.00

The expenses in cutting one bale of barit are:

For <i>zacatero</i>	₱0.10
For <i>cargador</i> ³	0.03
For <i>caminero</i>	0.03
Total.....	₱0.16

³The *cargador* is the laborer who carries the grass from the plantation to the railroad station.

The price of one bale of barit in Bay at the time of writing (January 1928) is ₱0.24. After subtracting ₱0.16 (expenses for cutting) from ₱0.24, it leaves a balance of ₱0.08. The farmer must receive some compensation for management or allow wages to hire a farm manager to do the work for him. One-fifth of the ₱0.08 (gross income per bale) or ₱0.016 per bale is generally paid for this labor. For miscellaneous expenses an additional expense of ₱0.004 per bale is incurred. If ₱0.016 is added to this miscellaneous expense or ₱0.004, it gives a total of ₱0.02. Deducting this total from ₱0.08, only ₱0.06 is left as gross gain on every bale of barit.

In Bay, about 6,000 bales of barit are produced from one hectare during the duration of the life of the plant which is about four years. Multiplying 6,000 by ₱0.06 it gives ₱360.00 as gross income from one hectare for four years. Subtracting from this the initial expense of ₱148.00, there is left ₱212.00 as net income for four years or ₱53.00 for a year. The tax of a hectare of land in Bay is ₱2.61. This tax reduces further the net income to ₱50.29 per hectare a year. Subtracting the interest (10 per cent) on the invested capital (₱148) for one year which is ₱14.80, we have ₱35.59 as net gain per hectare per year. The average assessed value of one hectare of barit land in Bay is ₱300. With the application of a given amount of labor and capital, for the production of barit, one hectare of land will yield a net income of ₱35.59 a year, or 11.85 per cent of its assessed value.

Summarizing the average expense and income from a hectare of barit in Bay, Laguna, we have the following:

Expenses:

Initial cost in planting one hectare of barit.....	₱148.00
Expense for cutting 6,000 bales at ₱0.16 per bale.....	960.00
Wages of the farm manager @ ₱0.016 per bale.....	96.00
Miscellaneous expenses @ ₱0.004 per bale.....	24.00
Land tax for four years @ ₱2.61 per year.....	10.44
Interest on capital invested for four years.....	59.20
Total expenses.....	₱1297.64
Gross income for four years (6,000 bales @ ₱0.24 per bale).....	₱1440.00
Net income for four years on one hectare.....	142.36
Net income per year per hectare.....	35.59

SUMMARY OF CONCLUSIONS

From the results of experiments actually conducted, the following conclusions may be drawn:

1. Old barit fields to which were applied the different kinds of commercial fertilizers responded differently to the treatment. Ammo-phos, hoz, and complete fertilizers gave the best results. However, the high production after the application of these fertilizers was not maintained in the succeeding cuttings; in the fourth cutting, six months after the application of the fertilizers, the yields were very low.

2. A native implement, *latak*, is effective in killing weeds. Tests on the effectiveness of this implement showed that it was able to lengthen the life of old barit fields, (see table 2).

As a result of the writer's investigation of the barit culture in Bay, Laguna, the following data were secured:

1. The barit industry in Bay, Laguna, is about seven years old. The fields devoted to barit growing are lowland and are in the vicinity of the railroad station.

2. The field for barit is prepared at the beginning of the rainy season and the method is very similar to that for lowland rice.

3. Planting is done by spreading barit cuttings over the field at the rate of about 200 bales a hectare. Barit is grown under irrigation water.

4. Barit fields in Bay are cropped seven times a year; the intervals between cuttings depend on the season. The life of an average barit field in Bay is about four years.

5. Weeds are the worst menace of barit. The *latak* is the common implement used to control the noxious weeds.

6. The average annual net income from one hectare of barit in Bay, Laguna, is about ₱35.00.

THE COMPOSITION OF COMMERCIAL SUGAR FROM PHILIPPINE CENTRALS¹

DELFIN J. SUERTE

The author studied the composition of centrifugal sugar from three sugar producing regions; Luzon, Negros, and Mindoro. His purpose was to secure valuable data which may be used as a working guide for the improvement of Philippine sugar for export. The results obtained are from the combined production of 265,726.658 metric tons from nine centrals or 56 per cent of the total production of the Philippine Islands.

The methods of analysis given by Deerr² and those in the Official Methods of Analysis³ were followed.

The results of the investigation disclosed the following facts:

- (a) That Philippine sugars have relatively high percentages of gums.
- (b) That the percentage of suspended solids and ash are comparatively low. In percentage of ash, Philippine sugars compare favorably with other cane sugars of the world.
- (c) That the moisture content is comparatively high. The Philippine sugar is open to improvement on this point.

The following tabulations give the average proximate composition and ash content of raw sugar for the crop 1926-27 of sugars obtained from nine centrals:

Polarization.....	96.66°	
Gums.....	0.68	per cent
Suspended solids.....	0.10	"
Moisture.....	0.87	"
Ash.....	0.30	"
Undetermined.....	1.39	"
Total.....	100.00	per cent
Aluminum and iron oxides.....	0.86 ± 0.01	per cent
Phosphoric acid.....	4.58 ± 0.04	"
Calcium oxide.....	8.58 ± 0.04	"
Magnesium oxide.....	3.10 ± 0.05	"
Potash.....	48.86 ± 0.06	"
Undetermined (carbon dioxide, sulfur trioxide, chlorine, soda, silica, etc.).....	34.02 ± 0.20	"
Total.....	100.00	per cent

¹The data here given were taken from a thesis presented in 1927 by Delfin Suerte for graduation from the College of Agriculture with the degree of Bachelor of Science in Agriculture with Certificate in Sugar Technology. The thesis was prepared in Department of Agricultural Chemistry under the direction of Dr. Manuel L. Roxas.

This paper was prepared by Dr. F. T. Adriano of the same department. Thesis No. 266; Experiment Station No. 540.

²Deerr, Noel. 1921. Cane sugar. 2nd ed., viii + 535 p., London: Norman Rodger.

³Anonymous. 1925. Official and tentative methods of analysis of the Association of Official Agricultural Chemists. 2nd ed., xvi + 535 p., Washington: Association of Official Agricultural Chemists.

TABLE 1
Showing the composition of raw sugar from different centrals

CENTRALS	TONS ^a	POL.	GUMS	SUS. SOLIDS	ASH	MOISTURE	EXCESS MOISTURE	UNDETERMINED	TOTAL
			<i>per cent</i>	<i>per cent</i>	<i>per cent</i>	<i>per cent</i>		<i>per cent</i>	
Bacolod.....	35,429.369	96.65	0.73	0.10	0.26	0.91	8.66	1.35	100
Binalbagan.....	34,971.728	96.80	0.61	0.09	0.27	0.86	7.50	1.37	100
Isabela.....	25,192.676	96.65	0.75	0.10	0.30	0.84	0.30	1.36	100
Ma-a-o.....	33,494.559	96.50	0.71	0.11	0.30	0.99	13.14	1.39	100
Talisay.....	35,470.709	96.65	0.66	0.09	0.32	0.90	7.46	1.38	100
San Fernando.....	30,393.386	96.70	0.65	0.10	0.29	0.87	5.45	1.39	100
Del Carmen.....	40,686.271	96.60	0.68	0.13	0.29	0.81	-4.71	1.49	100
Calamba.....	24,767.290	96.80	0.62	0.11	0.36	0.69	-13.75	1.42	100
San José.....	5,320.670	96.55	0.71	0.12	0.28	0.93	7.83	1.41	100
Totals and averages.	265,726.658	96.66	0.68	0.10	0.30	0.87	4.19	1.39	100

^a Metric tons.

Showing the composition of the ash of sugar from different centrals expressed per 100 ash

CENTRALS	TONS ^a	Al ₂ O ₃ , Fe ₂ O ₃	P ₂ O ₅	CaO	MgO	K ₂ O	UNDETERMINED	TOTAL
Bacolod.....	35,429.369	0.95 ± 0.01	3.90 ± 0.03	8.58 ± 0.03	2.78 ± 0.06	46.74 ± 0.06	37.05 ± 0.19	100
Binalbagan.....	34,971.728	0.61 ± 0.03	4.79 ± 0.04	8.93 ± 0.04	2.46 ± 0.05	47.66 ± 0.07	35.55 ± 0.22	100
Isabela.....	25,192.676	0.80 ± 0.02	3.69 ± 0.05	9.67 ± 0.05	2.69 ± 0.06	51.45 ± 0.07	31.70 ± 0.25	100
Ma-ao.....	33,494.559	0.80 ± 0.01	4.24 ± 0.04	8.56 ± 0.04	3.79 ± 0.04	49.71 ± 0.07	32.90 ± 0.20	100
Talisay.....	35,470.709	1.14 ± 0.02	4.72 ± 0.04	10.18 ± 0.05	4.24 ± 0.04	48.46 ± 0.06	31.28 ± 0.21	100
San Fernando.....	30,393.386	0.97 ± 0.01	5.21 ± 0.04	6.74 ± 0.05	2.88 ± 0.03	48.25 ± 0.05	30.95 ± 0.18	100
Del Carmen.....	40,686.271	0.79 ± 0.01	4.69 ± 0.05	7.67 ± 0.05	3.12 ± 0.05	50.53 ± 0.08	33.20 ± 0.24	100
Calamba.....	24,767.290	0.82 ± 0.01	5.14 ± 0.05	8.30 ± 0.05	2.52 ± 0.05	48.52 ± 0.06	34.70 ± 0.22	100
San José.....	5,320.670	0.78 ± 0.01	5.96 ± 0.05	9.32 ± 0.04	3.30 ± 0.04	48.38 ± 0.06	32.17 ± 0.20	100
Totals and averages...	265,726.658	0.86 ± 0.01	4.58 ± 0.04	8.58 ± 0.04	3.10 ± 0.05	48.86 ± 0.06	34.02 ± 0.20	100

^aMetric tons.

TABLE 3

Showing the composition of the ash of sugar from different centrals expressed per 100 sugar

CENTRALS	TONS ^a	Al ₂ O ₃ , Fe ₂ O ₃	P ₂ O ₅	CaO	MgO	K ₂ O	UNDETERMINED	TOTAL
Bacolod.....	35,429.369	0.002	0.010	0.022	0.007	0.122	0.097	0.26
Binalbagan.....	34,971.728	0.002	0.013	0.024	0.007	0.129	0.095	0.27
Isabela.....	25,192.676	0.002	0.011	0.029	0.003	0.154	0.096	0.30
Ma-ao.....	33,494.559	0.002	0.013	0.026	0.011	0.149	0.099	0.30
Talisay.....	35,470.709	0.004	0.015	0.033	0.014	0.155	0.099	0.32
San Fernando.....	30,393.386	0.003	0.015	0.020	0.008	0.140	0.104	0.29
Del Carmen.....	40,686.271	0.002	0.014	0.022	0.009	0.107	0.096	0.29
Calamba.....	24,767.290	0.003	0.019	0.030	0.009	0.175	0.124	0.36
San José.....	5,320.670	0.002	0.017	0.026	0.009	0.135	0.091	0.28
Totals and averages...	265,726.658	0.002	0.014	0.026	0.009	0.145	0.104	0.30

^aMetric tons.

NOTE: PRODUCTION OF PYRETHRUM FLOWERS IN JAPAN

Pyrethrum is a necessary ingredient of certain insecticides indispensable in the unceasing warfare against insects. Estimates of the extent of insect depredations in the United States alone exceed the enormous amount of one and one-half billion dollars annually. It is not surprising, therefore, that pyrethrum flowers, obtained principally from Japan, comprise a large proportion of the United States crude-drug and botanical imports.

In Japan approximately one-half of the total production of insect flowers, one of the most important natural products exported, is grown in Hokkaido, and the remainder is about equally divided among the four prefectures of Hiroshima, Okayama, Yehime, and Wakayama. At present the cultivation of pyrethrum is practically confined to the Dalmatian variety. Only small quantities of Persian pyrethrum are raised, for experimental purposes. Figures for the production of pyrethrum flowers in Japan during the 1927 season are not yet available but for the preceding year were 1,641,514 kwan, or 6,839 short tons.

Quality determined by oil content—Three types of plant

The quality of pyrethrum flowers is determined by the percentage of oil which they contain. A guild of pyrethrum flower growers and exporters in Kobe will certify the quality of any lot of flowers and various Government laboratories also make tests. The guild is not recognized by the Government as are many similar organizations.

Three types of the Dalmatian pyrethrum plant are grown in Japan. The first variety has a small dark-pink flower, blooms profusely, and shows a good harvest; the second has a light-pink flower but blooms in less profusion than the first; and the third has a greenish-white flower of considerably larger size than either of the other two types, but a much smaller crop. The Persian type, with its larger flowers, can be gathered sooner than the Dalmatian, thus making it possible to plant pyrethrum after the rice has been harvested. It is also hardier and much less subject to corrosion. The Dalmatian, however, has a much larger number of blossoms and a higher oil content, and, accordingly, is preferred in Japan.

Highest yield in third and last year of plant's life

The pyrethrum crop is harvested in the autumn, usually before the plants are in full bloom, since the buds are said to contain more oil than the flowers. It is estimated that over a period of three years, the life of the plant, the yield per ton (one-fourth acre) averages 827 pounds per year. The yield for the three years is in the ratio 1:2:3, the highest occurring

in the third year. The crop harvested in Hokkaido is stated to be of the best quality and that in Hiroshima prefecture second.

Local consumption increasing yearly

The consumption of pyrethrum flowers, as well as stems, in Japan during 1927 has been conservatively estimated at 250,000 to 300,000 kwan (1,000 to 1,240 short tons). The local use of insecticides is growing rapidly and greater quantities of pyrethrum flowers are required each year. Domestic manufactures include an insect powder, made from pyrethrum flowers; an incense stick, made of the poorer grades of flowers, and sticks and stems combined with leaves of other plants; a powder incense of similar consistency; and a liquid pyrethrum used for spraying. . .

United States take over 90 per cent of flower exports

Previous to 1915 only small quantities of pyrethrum flowers were exported from Japan. . . .

The United States takes over 90 per cent of the total exports of pyrethrum flowers from Japan. Exports to the United States during 1925 amounted to 52,934 piculs, valued at 5,448,000 yen, and during 1926, 61,236 piculs, worth 3,217,000 yen. (Picul = 132.27 pounds.)

—Commerce Reports (U. S.).

EXTENSION DIVISION NOTES

Prepared by Moises M. Kalaw under the supervision of Prof. I. Elayda, Director, Extension Service

A Visiting Graduate

Mr. Gregorio Francisco, B. S., '17, and Master Farmer in 1923 was a June visitor at his Alma Mater. He was on his way home from prospecting in Tayabas for a coconut plantation to purchase. Since his graduation Mr. Francisco has been engaged in commercial rice farming in Sta. Rosa, Nueva Ecija. His success in his farm business was so pronounced that a Filipino capitalist employed him as manager of an *hacienda* of 4,000 hectares in Talavera, Nueva Ecija. As this *hacienda* was new land, it was Mr. Francisco's task to clear it and bring it under cultivation. This hardest job in land development is now in full swing. His compensation as manager is on the share basis with his employer, with the privilege of managing his own farm, also.

In his management Mr. Francisco's effort is in the direction of making the land produce as much as possible and handling the labor so as to satisfy both his employer and his laborers. He claims this part of farm management is half the final success.

Mr. Francisco has recently been prospecting in the island of Mindoro for a possible location for agricultural development. He claims to have found in the interior of that island extensive agricultural areas capable of irrigation and suited to the growing of coconut, abaca, and other staple crops. He emphasizes the great value of water on any agricultural land, as he has seen poor and unproductive land turned to highly profitable land when supplied with irrigation water.

Asked as to the possibility of agricultural graduates finding employment on private farms, Mr. Francisco replied emphatically that it depends altogether upon the attitude of the graduates. If they are modest as to expected compensation, they would surely find employment in some private *haciendas*. He said that he would employ four or five recent graduates in the *hacienda* under his management if they would accept a salary of say ₱50 or ₱60 a month, having for their object practical training. They would thus get in line for an opportunity to get a job of greater responsibility provided their work justified a favorable recommendation.

He stated that training in practical agricultural engineering, farm practice, farm management, agricultural marketing, rural sociology, and laws related to land and farm business is necessary for success in practical productive agriculture.

Selecting Land for Farm Crop Production

Land selection is an important factor in reasonable success in farming. Among several things that wise selection of agricultural land involves, the climate is the supreme factor; then come soil in its various aspects, topography, drainage, crops intended to be grown, neighborhood, labor supply, market and transportation facilities. There are other factors depending largely upon what the individual prospector intends to do.

In actual prospecting for agricultural land with an eye to selecting the best available information from and the opinion of old settlers in the locality counts a good deal. These can be readily secured in places already settled and developed. It would be difficult, however, to get such information in a new country where settlement is sparse. In this case one has to depend upon his own knowledge and judgment. Selecting land in unopened regions is more difficult and is more expensive because of travel and time consumed.

It was gathered from reliable sources in Davao that the Moros' way of selecting land for their primitive agricultural practice is to visit, a day or so after a torrential rain, a place thought to be desirable. If they find no standing water anywhere on the land, they consider this favorable. In other words they want to make sure by actual inspection that the land is naturally well drained.

Negritos in some mountainous regions in Luzon seem to be inclined to select land for their small plantings (*cañgin*) that is provided with good

natural drainage. In cases actually seen their *cañigins* are located on mountain slopes where running streams are near the land.

But people used to agricultural ways in comparatively well-developed agricultural regions, when they take up land in other places, especially in a new country, are very careful in the selection of their farms. They invariably take into account before making a decision such important factors as climate, soil, topography, drainage, market and transportation facilities, neighborhood, etc., as mentioned above.

Careful selection of land for agricultural purposes can never be too much emphasized. It is the main basis of the undertaking from both the business side and the life of the family whether it is a question of buying developed land or taking up a piece of public land through the privileges granted by the Philippine Land Law.

Ranching on the Slopes of Taal Volcano

It may be of interest to know that the slopes of the world famous Taal Volcano, the only island volcano known, is now serving a good purpose in agriculture. This is true in spite of several eruptions, the last in 1911 when some thirteen hundred lives were lost. Although some parts of the slopes of this volcano have always been good agricultural land, it was not formerly farmed as extensively as now. Besides the crops grown, large areas are used as ranges for cattle, carabaos, and horses. It may not be an ideal range, but it certainly has several natural advantages. There are no streams flowing through the land where the animals can get water, but the surrounding lake supplies this lack. There is enough grass for the animals. No fencing is needed. The animals get salt from the sand and stones which are abundant. In short the animals on this range hardly need human care.

There are, however, some hard ranch problems. Having very little contact with man the animals are wild, and it is very difficult to catch them. Hence, branding and castrating is rarely attempted.

How to catch the animals is indeed puzzling, especially to a new comer. The volcanic mountain is a very large area of rolling land with many dangerous precipices. One who is not acquainted with its topography cannot easily travel over it. There are many places inaccessible even to animals. Under this condition the trailing of animals is difficult. Only familiarity with the volcano makes it possible. At present the caretaker of the ranch catches his animals when he desires, by methods which though very crude are certainly practical under the conditions. Young ranchers may learn much from him in the way of solving ranch problems similar to his.

EXCHANGE NOTES

The Department of Conservation of the State of Louisiana is issuing a Bird Day Program to all the schools in Louisiana, a plea for the conservation of our bird life that should be taken to heart not only by the school

children of the state but by every citizen, and especially the agricultural part of the population as the benefit done to the farmer by the birds in keeping down insect pests is incalculable. The various pests that now prevail in the sugar cane fields should lead the sugar planters to concrete planning to preserve the bird life of our state.

—*The Planter and Sugar Manufacturer.*

Rayon is something more than an achievement in textiles. It is another positive proof to us that science has never heard of the phrase "it can't be done."

—*The American Review of Reviews* (New York).

The Balance Sheet for Insects

Combatting insect life and repairing the damage it does has become one of the major industries of this country. Only last year an eminent authority concluded that the damage to crops, animals, and property by insects has increased until it nullifies the expended labor of approximately 1,000,000 men. In monetary loss, this approaches two billion dollars.

Fernald estimates annual losses due to insects in the United States, as follows:

Field crops.....	\$833,660,000
Animals and their products.....	431,450,000
Loss by human disease and death.....	350,000,000
Forests, forest products and materials in storage...	300,000,000
Farm wood lots.....	100,000,000

To this must be added extra losses on fruit and truck crops, shade trees and ornamental shrubs and plants, and household goods and food. The damage done by clothes moths is close to \$200,000,000 yearly, and fly screens cost this country about \$50,000,000 per year.

Values Created by Insects

The approximate yearly production of the domesticated insects of the world is:

Raw silk.....	\$400,000,000
Shellac.....	20,000,000
Honey.....	20,000,000
Beeswax.....	4,000,000

Some minor products include cochineal, from which carmine is made; cantharides, used in medicinals and cosmetics; tannin for writing ink (resulting from the stinging of oak trees by a wasp); and, at times, food for birds, fish, and hogs. Besides these direct contributions, insects perform the incalculable service of pollinating most of our finest vegetation, including fruit trees, several kinds of crops, and nearly all flowers.

—*Industrial Bulletin* of ARTHUR D. LITTLE, Inc.

It is doubtful whether any kind of soil treatment pays a bigger interest on the investment than inoculation. Such a condition is not unexpected for not only are the benefits derived from inoculation large but the cost of such treatment is surprisingly small. In fact the latter may require only the expenditure of a few odd moments when the farmer is free from other necessary chores. It is not inferred, however, that inoculation can take the place of other soil treatment for the former is most effective upon soils in which the lime requirement has been satisfied and where the supply of available minerals is adequate for maximum yields. . . .

The object of inoculation is to supply the soil with bacteria suitable for nodule production on the legume which is to be grown on the land. . . .

Nodule bacteria may be secured from a large number of commercial laboratories at a cost ranging from 20 cents to \$1 for a quantity sufficiently large to inoculate one bushel of seed. Reliable cultures are not only easy to handle but in addition there is no chance of transplanting weed seeds or injurious plant diseases.

—*Prairie Farmer* (Illinois).

COLLEGE AND ALUMNI NOTES

Dr. F. W. Foxworthy, formerly Dean of the Forest School, spent a few days on the Campus in June. Doctor Foxworthy for the past ten years has been Director of Forest Research in Federated Malay States, with headquarters at Kuala Lumpur. Doctor Foxworthy was returning from a leave of several months, five of which he spent in Africa. He traveled from Capetown to Cairo not by the most direct route, but by devious ways covering much territory.

Miss Anna F. Cole from Kenmare, North Dakota, succeeds Miss Whipple as instructor in English. Miss Cole was graduated from University of North Dakota with degree of A.B.

The last week of the summer course in Engineering 1-C was conducted in camp. There were forty-three students in the class. Dr. Alexander Gordon and Mr. Agapito Muyargas, graduate assistant, were in charge of the work. The first camp was near College Station and the second near the School of Forestry. The principal work was survey of the College Experiment Station.

The work closed with a *lechonada* celebration to which Dean Gonzalez and eight Co-eds were invited.

Mr. Catalino Acosta, member of Senior Class 1928, but completing work *ad interim* is teaching in Batac Farm School, Batac, Ilocos Norte.

Eladio Francisco, son of Gregorio Francisco, B.S. '17, is registered in the preparatory course this year. This young man has the distinction of being the first son of a College of Agriculture graduate to register in the College. Age is creeping on our institution.

SOME POSSIBILITIES IN BREEDING PLANTS USED FOR COVER, GREEN MANURE, AND SHADE¹

The greatest development in the use of plants for cover, green manure, and shade is found in countries where permanent crops are grown on the scale of an estate as in Java, Sumatra, Federated Malay States and probably also in India, Ceylon, and other countries. In these regions perennial crops such as rubber, cinchona, coconut, oil palm, tea, coffee and the like are more important sources of profit than some annuals like rice, maize and similar food plants.

In Java, estate managers wage a constant war against weeds. This fight is so intense that to eradicate and control the weeds either the clean culture system is employed or cover crops are grown not only between rows of plants but in every conceivable nook and available spot on the plantation, even right in the paths and roads of the farm. Some of the cover plant species used are also turned under as green manure or used to shade nursery plants and those newly transplanted in the field.

The largest collection I have seen of plants used and being tested as green manure, and for covering spaces between cultivated plants to control weeds, and for shading nursery plants and young plants in the field—aid plants, as they may be called for brevity—is that belonging to the Tea Experiment Station at Buitenzorg, Java. The collection consists of plants already in general use as well as wild plants collected in Java and of plants of different species from many tropical countries. Any one interested in the list of the aid plants used in Java should consult the works of Backer and Van Slooten (1924)² for cover and shade plants and green manures and of Wigman (1926)³ for road trees. Some of the most important species in the collection are: *Acacia decurrens* Willd., *Cajanus cajan* Millsp., *Calopogonium muconoides* Desv., *Cassia mimosoides* L., *Crotalaria anagyroides* H. B. K., *Crotalaria usaramoensis* Baker, *Desmodium gyroides* D. C., *Indigofera hendecaphylla* Jacq., *Indigofera sumatrana* Gaertn., *Leucaena glauca* (L.) Benth., *Mimosa invisa* Mart., *Sesbania grandiflora* Pers., *Tephrosia noctiflora* Bojer, *Tephrosia Vogelii* Hook., and *Vigna Hosei* Backer.

The strange thing about the use of these aid plants is that, with few exceptions, no thought has been given to selection, even among the varieties

¹ General contribution from the College of Agriculture No. 205.

² Backer, C. A. en D. F. van Slooten. 1924. Javaansche theekonkruiden en hunne beteekenis voor de cultuur. Algemeen Proefstation voor Thee. Java.

³ Wigman, H. J. 1926. Wegboomen No. 2. Publicatie van de Nederlandsch Indische Wegenvereniging, Bandoeng, Java.

making up each species, not to speak of individual strains and plants within a variety. The unit taken so far has been usually the species, and when one of these does not satisfy, the tendency, naturally, has been to follow the route of least resistance; namely, the trial and use of other species. This is passing strange when it is realized that the use of cover crops, green manures, and shade plants is as essential as the planting of the regular economic plants with which they are generally grown and that many species in use, despite their undesirable characters, have never been replaced by others.

Road plants are more or less permanent in nature and the choice not only of proper species for a given locality but also of varieties and healthy and vigorous plant materials can not be over-emphasized. Practically no attention is given to this phase of the work. Seedlings of different varieties and ages are planted promiscuously. It is time that some serious thought be given to this point by those in charge of the roads.

There are still so many species of plants untried for their value as shade plants, and as cover plants and green manures that for a long time experiment stations and estate managers and planters have been content to try uninvestigated species to replace undesirable ones in use instead of performing selection or improvement with them. The time seems to be approaching, however, when plant breeding will be called upon to improve some of the most valuable species now under cultivation. The cause of the failure of some of these plants to keep up their reputation has been the lack of selection. For example, formerly, *Erythrina* species were in high esteem as shade trees. According to Alberts⁴, lack of proper selection has been one of the main causes of its being less important at present in this respect than *Leucaena glauca*.

That the species widely used have their respective defects is known to all those who have had long experience in using them. Some examples may be cited. *Mimosa invisa* Mart. is considered one of the best, if not the best, species for use in eradicating and controlling weeds, and is generally used in eradicating the *cogon*, or *alang-alang* (*Imperata cylindrica* (L.) Beauv.). *M. invisa* produces an abundance of seeds, is self-sowing, or self-perpetuating, grows satisfactorily, and is not troubled by insects or disease. It gives a good amount of humus and is a good green manure. Its only defect seems to be that its stem is thorny. When it is so planted that a roller can be used to bring it down before it is plowed under, the thorniness is not a very great disadvantage. Under some circumstances a roller can not be used and it has to be handled by laborers who greatly dislike the thorns for they cause scratches and pricks which at times require prolonged medical treatment. It has been said that a thornless variety of this species would be worth a million pesos. Mr. L. Koch of the General Experiment Station

⁴Alberts, G. A. 1915. Lamtoro als schaduw. Mededeelingen van het Proefstation Malang. No. 10.

at Buitenzorg made an attempt to select plants on the basis of the length of the thorn with a view to ultimately eliminating it, but no positive results were obtained. Here, then, is a wide field for service for plant breeders. Mr. A. A. M. N. Keuchenius, who is in charge of the green manure and cover crop garden of the Tea Experiment Station in Java told the writer he was trying to attack this thorn problem with the *M. invisa* by crossing it with *Neptunia plena*, which is thornless and looks somewhat like the *Mimosa*, although not so thickly growing. Let us hope a thornless hybrid will be produced that is *M. invisa* in many respects but is without the thorn.

Meanwhile our local Bureau of Agriculture is forced to study the question as to whether the propagation of *Mimosa invisa* in the Philippines should be allowed or should be prohibited because it might become an undesirable weed. Were it spineless there would be no hesitation in encouraging the spread of this very important legume.

Leucaena glauca is used generally in Java, especially on tea estates, as a shade plant. It is periodically pruned. It is also planted thickly as a low hedge along the edges of terraces to prevent erosion on slopes. The roots of *Leucaena* penetrate the ground so deeply, even the hard subsoils, that in certain places it has been used to drill holes through hard subsoil for purposes of drainage. This species is not troubled by leaf diseases. The main defect of *Leucaena glauca* as a shade plant is that it grows so fast and recovers so fast after pruning that the cost of upkeep is rather high. For this reason the Tea Experiment Station at Buitenzorg is trying to find some other species better than *L. glauca*. Another defect of *L. glauca* is that it is a heavy seed producer, and drops seeds constantly, and the seedlings from these seeds, especially in places of fairly uniform rainfall throughout the year, make frequent weeding necessary. Doctor Cramer of Java once started selection of parent trees with sparse seeding habit to eliminate this special defect and this work evidently was attended with success. It is said that sterile and almost sterile strains were found.

Experiment stations in other countries may follow the examples set by Dutch plant breeders in Java. They can enlarge the scope of their work by thoroughly studying the plant breeding possibilities with the plants they use for cover, green manure, and shade, and start isolation and hybridization work with these important aid plants.

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CHEMICAL STUDIES ON COCONUT PRODUCTS: II. UTILIZATION OF THE COCONUT¹

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Coconut, which in 1906 for a second time became nationally important to the Philippines, is now the country's second greatest export. According to the Bureau of Commerce and Industry, the yearly production of copra in the Philippines for the last ten years has been around 350 million kilograms; the value of the exported oil, copra, cake, and desiccated coconut for 1925 was ₱76,580,957 or about 27 per cent of our total exports. Figures from the Statistical Bulletin of the Philippine Islands show that the Philippines furnishes about one-third of the world's supply of copra. Efforts are being made in some countries to bar coconut oil from the market that some other oils may be favored; the final outcome will depend upon the cheapness of production of coconut oil. And the cost of production will depend not only upon proper fertilizing of the plantations, sound farm management, and marketing, but also upon the extent to which the waste products of coconut may be utilized.

The object of this paper is to review briefly the uses which the Filipinos and the industries have found for the different parts of the coconut plant, and to point out a few studies that could be made regarding some of its products.

Of the different parts of the coconut palm; namely, the roots, trunk wood, leaves, and nuts and flower spathe, hardly anything will be wasted under proper management.

THE ROOT, TRUNK, AND LEAVES

The roots contain tannin, and according to Sampson (1923) have been used as an astringent. The wood, if old and seasoned by soaking in salt water for about a month, may be used as posts, flooring, and rafters for houses; if well polished, it will serve as material for cabinet work and canes. The waste wood may be used for fuel, to make feeding troughs for pigs, and floats for fishing nets.

The leaves if taken green can be used as material for screens and partitions, windows, mats, and baskets, as well as for raincoats and hats. The young leaves, called *palaspas*², are used for wrapping rice cakes called

¹Experiment Station contribution No. 541. Received for publication, June 26, 1928.

²On Palm Sunday the *palaspas* is carried to church to be blessed. The Filipinos use them as a charm against earthquake and lightning.

suman. The midribs may be used to make brooms and baskets. The young petiole may be used for tying purposes. From the fibrous stipule, brushes and hats and native raincoats may be made; it can be used also as substitute for horsehair for stiffening clothing and furniture (Sampson, 1923). The fibers in the inner spathe are used in place of rope for tying fences; this rope stands the weather as well as any other.

In case the coconut plant is found unproductive or is attacked by some disease, it may be cut down and the young stem tissues, the cabbage, may be used for food as a salad. The leaves, when burned, yield an ash rich in soda potash and phosphoric acid which may be used for making soap, or as a constituent of fertilizers.³

THE NUT

Of all the parts of the coconut, the nuts give the most income. From these come the meat, the water, the shell, and the husk.

The meat may be taken fresh from the nuts and when cleaned and shredded and thoroughly dried under partial vacuum, the product is sold as desiccated coconut; this is widely used as an ingredient in puddings, cakes, pastries, and candies.

Locally, the fresh meat is grated and pressed with hot water to give a thick emulsion called *gata*. This is used much the same as cow's milk in making various desserts; it is also heated and the oil separated, leaving a nitrogenous residue, *latek*. Both the oil and *latek* are used for food.

The meat and water of the young coconut, known as the *buko*, are widely used on warm days, in much the same way as ice cream or cooling drinks. In localities where the source of water is not well known or considered sanitary, travelers rely wholly upon the water of the young coconut. Furthermore, it has been observed that young coconut water is a good diuretic.

When grated meat is dried with sugar the product is commonly known as *bukayô*, a sweet, very much in demand among Filipinos.

The bulk, however, of fresh meat is first treated to produce the copra, which is later pressed for oil. This is the method used to prepare oil on a commercial scale. The oil may be used directly in the manufacture of soap and candles. The crude oil is sometimes used by Filipinos for illuminating purposes. Soaps prepared exclusively from pure coconut oil were shown by Walker (1926) to be very effective disinfectants against typhoid bacilli, paratyphoid bacilli, and dysentery bacilli.

The stability of pure coconut oil makes it a good ingredient in the manufacture of many toilet preparations, such as creams and pomades

³ Analysis of the ash of the pinnae in the laboratory of the Department of Agricultural Chemistry in this College shows the following results: $K_2O = 9.67\%$; $Na_2O = 2.77\%$; $P_2O_5 = 1.93\%$; the ash of the petiole was found to contain 10.67% Na_2O ; 18.71% K_2O ; and 7.27% P_2O_5 .

Experiments on the rate of hydrolysis of coconut oil, carried out in the Chemistry Laboratory in this College show that when placed in a glass container, pure coconut oil hydrolyses to only a very slight extent.

TABLE 1
Showing rate of hydrolysis of pure coconut oil

AMOUNT OF WATER MIXED WITH THE OIL	OLEIC ACID AT THE BEGINNING		OLEIC ACID AT THE END OF 4 MONTHS		RANCIDITY
	Covered	Uncovered	Covered	Uncovered	
<i>per cent</i>	<i>per cent</i>	<i>per cent</i>	<i>per cent</i>	<i>per cent</i>	
37.61	.15	.15	.44	.44	Negative
38.71	.15	.15	.60	.45	"
23.11	.15	.15	.60	.45	"
16.81	.15	.15	.45	.60	"
10.00	.23	.23	.46	.53	"
3.96	.23	.23	.46	.46	"
.11	.23	.23	.31	.31	"

From table 1 it is evident that pure, or refined coconut oil may be used in the manufacture of vegetable lard⁴, oleomargarine and ointment; in fact, stable emulsions, such as mayonnaise, etc., have been prepared by Ayre (1923) from refined coconut oil.

Coconut oil has been shown by Cohn (1924) to be an adulterant of cacao butter, and Southcombe and Wells (1920) have shown that it can be used as an adulterant in lubricants. It has been recommended by Spiers and Bitte (1926) as a constituent in the preparation of a mixture for oiling scoured wool. Keghel (1913) found it very useful as a constituent of a solution for the industrial preservation of eggs. Artificial petroleum which has been prepared from soybean oil and fish oil has been prepared by Kobayashi (1921) from coconut oil by heating the oil with Japanese acid clay. It has, furthermore, been found by Rivera (1925) that coconut oil has a slight curative effect on leprosy.

When the oil is subjected to distillation with one to two per cent sulfuric acid, the fatty acids and the glycerol are separated. Glycerol can be obtained also as a by-product in the manufacture of soap.

COPRA CAKE

The residue, after pressing the copra for oil, is called copra meal, or copra cake. It contains about 10 per cent of oil and 17-18 per cent of protein. Copra cake is generally used as cattle and chicken feed. According to Lindsey (1914) its nutritive value is equal to that of gluten feed, and if given in sufficient amount to cows it helps in producing butter which

⁴In order to manufacture cooking fat from coconut oil it is first hydrogenated to harden it, but this result may be accomplished with the use of some animal or vegetable oil of high melting point.

is firm in texture; furthermore, Ewing and Spence (1918) found that butter from copra cake fed cows has a high fat content. In the East Indies, copra meal has been suggested by Jansen (1921) as a useful protein for man when food is scarce. A combination of copra meal and rice bran has been shown by Allas (1924) to be a good supplement to camote vines for feed for growing pigs. However, Sulit (1926) found that if the cake is given in great amounts to rats it acts as poison.

Copra cake is valuable also as a fertilizer. Jaojoco (1923) found that the cake contains 19.89 per cent P_2O_5 and 8.14 per cent K_2O .

COCONUT WATER

The water of the coconut may be used for making fermented beverages; the Filipinos mix the water with corn starch and make vinegar. According to Léonard (1925) coconut water which has been allowed to ferment for four to five days will coagulate rubber latex and produce a rubber of good color and purity.

COCONUT SHELL AND HUSK

Various uses are made of the shell of the coconut. It is often made into bowls for ornamental purposes, into household utensils, carved articles, rubber-tapping cups and stringed instruments. According to the patent of Schwinger (1915) the shell may be used in the manufacture of colored buttons, and the shavings of the shell used for polishing hard colored articles. It is used also in the manufacture of corks. The shell is a good fuel, either as charcoal or untreated. The charcoal when properly prepared is extensively used in the refining of sugar, decolorizing of colored liquids, etc., and as an ingredient in the chemical purifiers in gas masks. It has been used by Shober (1910) as an absorbent in radium therapy. Coconut shell charcoal also serves as a catalyst in the production of alcohols and aldehydes from gaseous hydrocarbons. Kloppenburg (1924) synthesized methyl alcohol and formaldehyde from methane by oxidizing the hydrocarbon in the presence of coconut charcoal.

When a mixture of shell and coconut husk is subjected to distillation, an acid liquid is distilled. This distillate has been found by Stevens (1921) to coagulate rubber. When the shell or the husk is burned, it produces an ash rich in soda, potash, and phosphoric acid. Hence, the ash may serve as a source of alkali in the manufacture of soap or as a constituent of fertilizers.⁵

From the husk, coir fibers that can be used in the manufacture of rope, twine, matting, rugs, and carpet, and also for brushes and brooms and mops may be made. It has been calculated by Holonesky (1926) that from 1000

⁵ As found in the College Experiment Station Laboratory, the ash of the shell contains 5.80% Na_2O ; 23.5% K_2O ; and 4.96% P_2O_5 , and that of the husk contains 2.29% Na_2O ; 30.19% K_2O ; and 5.94% P_2O_5 .

husks, 60 kilograms of spinnable fiber and 7.5 to 12.5 kilograms of stuffing fiber may be obtained. The spinnable fiber can be used, according to Von Uffel (1919), in manufacturing fire-proof roofing. There are a number of uses for the coir fiber. It is used in the place of hemp in the manufacture of rope and twine. Cordage made from the coir stands exposure to weather and water better than that made from some other fibers. The coir is also used for making door mats and floor mops. According to Sampson (1923), coir fiber is even made into belting for driving machinery. The stuffing fibers may be used in the manufacture of corks. The possibility of using coconut fiber as a raw material for some classes of paper or paper pulp has been suggested by Richmond (1906). The fibers also serve as a good fuel and for stopping of leakage.

THE FLOWER SPATHE

In many localities the coconut is raised not for the nuts but for the flower spathe. This, on being cut properly, yields toddy which may be used as a beverage, either fresh or fermented, or it may be made into syrup, palm sugar, or vinegar.

SUMMARY

The coconut products which are very much in demand at the present time are oil, copra, copra cake, and desiccated coconut. During the world war, coconut charcoal was extensively utilized in making gas masks, and with proper preparation it may be used for refining sugar. The sap from the spathe is extensively used in making fermented beverages. In passing, it may be pointed out that at the present price of the fermented drink in the Philippines, it is more than twice as profitable to cultivate the coconut for the toddy than for the copra. Coconut coir is used in the manufacture of cordage and upholstery.

It would be interesting to find out whether the system practiced in the sugar centrals as applied to sugar production cannot be applied in coconut plantations. Conditions under which copra is handled make the price of the oil relatively much higher than if it were obtained directly from the fresh nuts. These conditions are: under the present method of handling copra for export a large percentage of the oil is lost in transit owing to the action of molds; the inconvenience of handling copra because of the impurities, such as sand, nails, etc., deliberately thrown in by the middlemen; and that in order to get high grade oil, refining is necessary. The main difficulty in obtaining the oil from fresh coconut meat seems to be the lack of knowledge about the method of separating the protein colloids from the oil.

Other important investigations that may be carried out with profit are the utilization of copra cake for fertilizer and food, and the manufacture of charcoal for sugar refining from coconut shell.

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PATHOLOGICAL LESIONS CAUSED BY AN UNDESCRIBED COOPERIA IN A CARABAO¹

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WITH ONE PLATE

In the course of an experiment on tuberculosis in carabaos (*Bubalus bubalus*), an unusual case of intestinal parasitism caused by an apparently undescribed species of nematode was discovered by the writer. A piece of the intestinal wall preserved in Kaiserling was sent for identification to Dr. Benjamin Schwartz of the United States Bureau of Animal Industry. In his answer to the writer, Doctor Schwartz expresses the belief that the parasite concerned belongs to an undescribed genus *Cooperia*.

For the purpose of recording the pathological lesions caused by this parasite in the carabao the following protocol is submitted.

HISTORY

On August 30, 1926, six young carabaos were obtained for experiments on tuberculosis. One of these carabaos, No. VI, one and a half years old, which was given intravenously five milligrams of a culture of *Mycobacterium tuberculosis* suspended in 2 mls of 1-10,000 sterile solution of sodium carbonate, became extremely emaciated. On May 20, 1927, this animal was found to be too weak to support its own weight. So it was decided to kill it with 15 mls of tincture of nux vomica injected intracardially.

MORBID ANATOMY

On autopsy, the following lesions were found:—The blood was pale and watery; there were marked and extensive serous infiltrations of the subcutis, mesentery, and peritoneum; the fat on the coronary region of the heart, the pelvis of the kidney, and mesentery had a gelatinous appearance; the spleen, liver, kidneys, and heart muscle were atrophied and pale; the lungs were pale and crepitant; the most conspicuous lesion consisted in the presence of numerous parasitic nodules throughout the mucous membrane of the small intestine, starting from a few centimeters from the pyloric end of the stomach and extending to the entrance of the ileum into the caecum. These nodules were numerous at the duodenum and jejunum and fewer in number toward either end of the small intestine. They were at first taken for tubercle nodules, but on close inspection the error was apparent. They were found to be 4 mm. in diameter, 2 mm. in height protruding into the

¹ Experiment Station contribution No. 542. Received for publication May 28, 1928.

lumen of the intestine. There was a pin point opening in the center. (See plate I.) Upon carefully teasing out the fibrous capsule of a nodule in salt solution, a small, slender nematode coiled upon itself was liberated.

No evidence of tuberculosis was observed in any of the organs of the carcass. Histological examination of sections of these nodules revealed that they were composed of a fibrous connective tissue capsule within which a cross-section of the parasite could be seen. Inside this capsule numerous young fibroblasts and lymphocytes could be seen surrounding the parasite. In some places, the fibroblasts appear in reticular strands. The mucosa immediately opposite the nodule was atrophied because of pressure, and in some nodules the intestinal glands had undergone necrosis and disappeared. There was a marked lymphocytic infiltration of the mucosa and adjoining tissues.

It is probable that the worm pierces the mucous membrane of the intestine at the pin point opening on the surface of the nodule and its progress through the wall of the intestine is stopped by the muscularis as the local tissue reactions do not extend beyond this layer.

EPICRISIS

The cause of death was due to inanition. The presence of numerous parasitic nodules throughout the mucosa of the small intestines and the degeneration of the intestinal glands impaired digestion and assimilation, resulting in extreme emaciation and death.

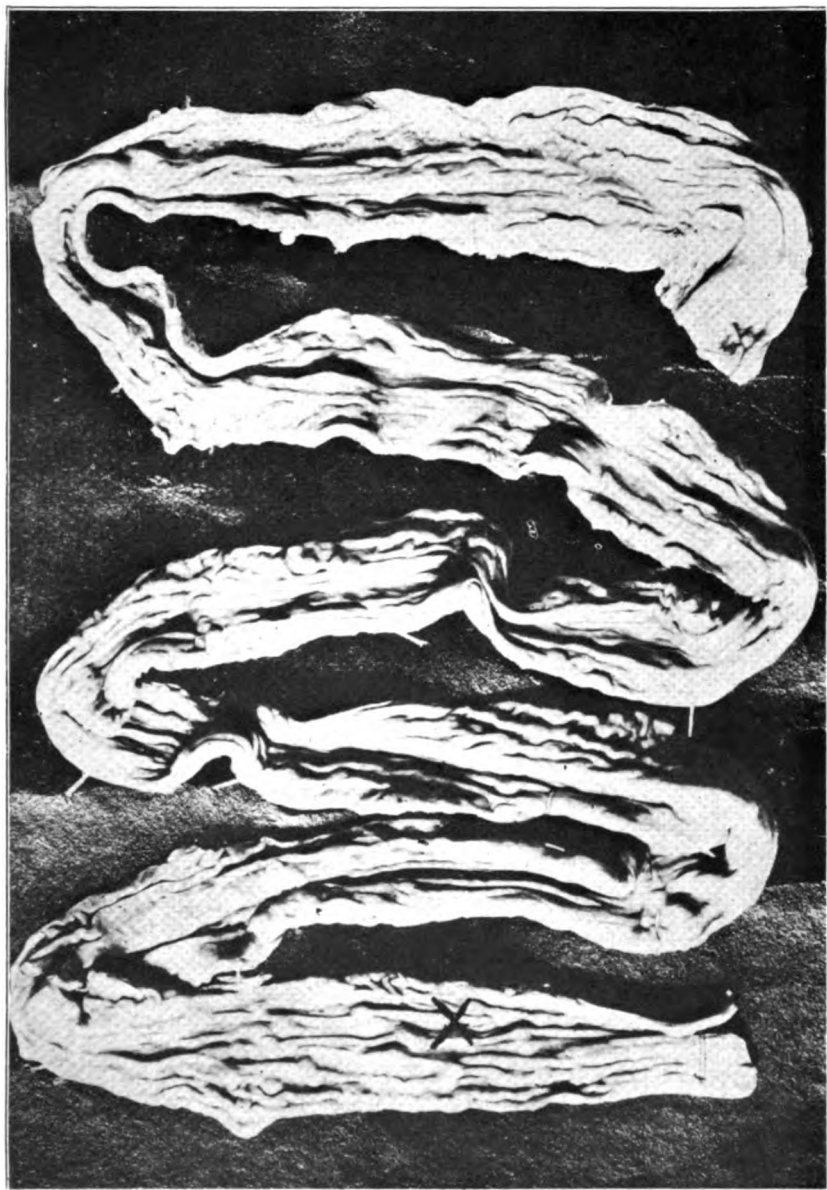


PLATE 1.—Portion of small intestine of carabao showing parasitic nodules.
X a nodule showing pin point opening.

EFFECTS UPON RICE PLANTS OF CHANGING THE MOISTURE CONTENT OF SOIL¹

FELICIANO T. PANTALEON

INTRODUCTION

Rice plants, especially the lowland variety, need much water for proper growth and development and are known to be affected materially by drought and lack of sufficient water in the soil.

Investigations on relation of water to rice have been carried out in different countries, but for the most part on water requirements of rice plants and on the effect of different depths of submergence. A review of available literature failed to find any study on determining how far healthy young rice plants can endure a sudden reduction in the supply of moisture in the soil, and what the ultimate effects of this condition would be upon the yield of straw and grain, should the plants be supplied again with sufficient water until complete maturity.

Previous studies on water requirements and on the effects of submergence will not be reviewed here as they are not directly related to the present study. The two available reports somewhat concerned with the subject are only abstracts. One reports that Hellriegel *et al* as cited by Pfeiffer *et al* (1920) found that intercalated waterings when water was lacking in the soil were harmful to plants. These authors found also that even a large amount of water supplied to the plant during a period of drought was not sufficient to repair the injury which the plant had received. The other study, also cited by Pfeiffer *et al* in their report, is that of Gain, who is reported to have observed that a certain quantity of water applied to the soil after a slight drought gave better results than the continuous supply of moisture, even when this was at an optimum amount.

Object of the present study

The objects of this study were: (1) To determine how far rice plants can endure the lack of sufficient moisture in the soil; and (2) to determine how far the rice plants so treated can recover should they be supplied again with water in sufficient quantity.

Time and place

This investigation was begun on June 18, 1927, and was closed on December 23, 1927. It was carried out near the Plant Physiology Depart-

¹ Thesis presented for graduation, 1928, with the degree of Bachelor of Agriculture from the College of Agriculture No. 266; Experiment Station contribution No. 543. Prepared in the Department of Plant Physiology under the direction of Dr. Rafael B. Espino.

ment, College of Agriculture, Los Baños, under an improvised portable shade which protected the cultures from the rain.

MATERIALS, METHODS, AND RESULTS

Two varieties of rice were grown in 96 pots containing clay loam soil. They were Inintiw variety, which can be grown under upland and lowland conditions (Abesamis, 1921); and Macan Kumpol, a lowland rice. Twenty-four cultures were employed for each variety, or forty-eight cultures in all. For convenience in reference, the two sets of cultures are here designated as the "lowland set" and the "upland set".

Five selected seeds were sown in each pot. Quite uniform germination was obtained. Later, the seedlings were thinned to three uniform plants which were properly watered and exposed to the sun whenever the day was clear. This treatment was continued until the end of forty days. Then, with the exception of two cultures in each set, the supply of water of the cultures was discontinued. The two cultures in each set that received a continuous supply of water were employed as the control, or for comparison. After ten days, two pots from the upland set and two pots from the lowland set were again supplied with water every day until the cultures were harvested. Water was further withheld from the rest of the cultures, and was again given to them only after 17, 24, 31, 38, 45, 52, 59, 66, 73 and 80 days. Two cultures from each variety set were given the same treatment. Further explanation on how the treatments were given the cultures may be found in tables 1, 2, 3, and 4. With the exception of the cultures II, samples of the soil in each pot were taken and their moisture content determined by ordinary gravimetric method.

Two other sets of cultures were started. The materials and methods employed were quite similar to those employed in the first two culture sets. However, there was a slight change in the method. In these two sets, the pots were put on pieces of wood so that they were about three centimeters above the ground instead of being on it as in the first two sets of cultures. The period from the time the supply of water was cut off to the time when water was again supplied was made shorter. In the first two sets, the intervals were seven days, and in the later sets the intervals were made only five days. This change was made due to the fact that many of the plants in the first sets of cultures died owing to prolonged withholding of water. The cultures in these sets were supplied with water daily for thirty days,—one liter of water to each culture in the upland set and two liters to each pot in the lowland set. In the lowland set, the surface of the soil in each culture was submerged to a depth of three centimeters; while the soil in the pots in the upland set was kept only moist. At the end of thirty days, except in two cultures from each set, the supply of water to the pots was cut off entirely. However, five days later, two cultures from each set were again supplied with water daily until maturity. The other cultures received,

again, water daily beginning ten days, fifteen days, etc. (see tables 3 and 4) from the time water was withheld entirely until maturity. The two cultures from each set that received water daily until maturity of the plants served as control.

Observations were made from time to time on the general vigor of the plants in the different cultures. The date of blooming and date of maturity of the grain were noted. At the time water was withheld, the height of each plant in the different cultures was measured from a certain base mark at the level of the soil in the pot to the tip of the highest leaf. At maturity before the plants were harvested, the height was again measured from the base mark to the tip of the "boot" leaf. The grains and straw harvested separately from each culture were dried in the room and then air-dry weights were determined. The experimental data thus obtained are shown in tables 1, 2, 3, and 4. Some of these figures are averages and were obtained under the following criteria:

a. *Average height of plants at the time water was withheld.* The height of each plant in each culture was measured from a base mark to the tip of the highest leaf. The heights of the three plants in each culture were added and the average height found by dividing the sum by three.

b. *Average height of plants at harvest.* Following the method employed in (a), the heights of the three plants in each culture were determined at the time of harvest. The data thus obtained were added together and divided by three. The quotient is the average sought.

c. *Average increase in height from the time water was withheld until harvest.* The numerical data under this criterion were obtained by subtracting the data in (b) from the corresponding data in (a).

d. *Air-dry weights of straw and grain.* The method which was followed in obtaining the data under these criteria is described under "Materials, methods, and results."

e. *Number of days to maturity.* This is the number of days from the time the seeds were sown to the day when the plants in each culture were harvested.

Weather observations were also made. As recorded by a thermograph which was placed near the cultures, the maximum air temperature ranged from 27°C. to 32.5°C. during the day; the minimum from 22.6°C. to 25.5°C. during the night.

An improvised movable shade (V-shaped) made of bamboo frame and thatched with nipa, protected the cultures from rain. This shade was made so it could slide on three bamboo parallel beams placed horizontally one meter above the ground. As records on precipitation are not here needed they are not included.

Whenever the sky was clear the plants were directly exposed to the sun. Of course, on rainy or cloudy days the plants received only diffused

sunlight. On the whole, however, the cultures received a normal supply of sunlight during the entire culture period.

DISCUSSION OF RESULTS

The results from this study are here presented in two parts: (a) those from the first plantings, and (b) those from the second plantings. The observations made on the external appearance of the plants from both plantings are given under one heading.

External appearance of plants

The plants in the different cultures in which the water supply was cut off for different lengths of time behaved differently. Some of the plants were injured severely, as shown by drying of leaves; while others were apparently not affected at all. While the plants in cultures IIa and IIb of the upland set and the lowland set in both plantings did not suffer at all from the lack of moisture in the soil when the supply of water was cut off only for five or ten days, the other cultures whose water supply was cut off for a longer period of time suffered materially, resulting in the death of the plants in some extreme cases. The plants in cultures IIIa and IIIb and in the rest of the cultures felt the insufficiency of moisture in the soil, as was shown by rolling of the leaves followed by drying of tips and complete drying of some leaves at the base. The rolling or folding of the leaves was noticed on the twelfth day from the time the supply of water was cut off. Early in the morning, however, the leaves of the plants were found open again, but they began to roll as the day advanced. This condition of the leaf remained for some time but finally a marked drying of the leaves took place (see tables 1 to 4). From these observations on the external appearance of the plants, it becomes evident that cutting off of the usual supply of water from the soil, if water is supplied again in five to ten days, proved not only that it was not harmful to the plant, but even stimulating, as the plants so treated, later on, became more thrifty than those in the control cultures. These observations confirm those of Gain, as cited by Pfeiffer *et al* (1920), who is reported to have observed that a certain quantity of water supplied to the soil after slight drought gave better results than the continuous supply of moisture, even when this was at an optimum amount.

Straw and grain from first plantings

As shown in tables 1 and 2 the results obtained from the duplicate cultures were quite similar. For this reason, the data under the same criterion in tables 1 and 2 were averaged and the results are recorded in table 5. This procedure was followed for both the lowland set and the upland set.

The upland set. Examination of the data in table 5 shows that the average heights of the plants at harvest were different,—indicating that the methods of watering had material influence on the growth in height of the plants in the different cultures. Under this criterion, the control plants

which received a continuous supply of water were not any better than those which were deprived of the optimum amount for a period of ten days, confirming again the results obtained by Gain. A difference of 16 per cent in favor of the latter culture is shown in table 5. The cultures whose optimum water supply was withheld for 17, 24, and 31 days produced plants much shorter than those of the control. The plants grown in the cultures that were deprived of the usual supply of water for a period of not less than 38 days, died.

The yield of straw was also affected by the amount of water supplied to the plants. As shown in table 5, culture II, in which the 40-day old plants were deprived of the usual amount of water for 10 days, not only regained their former vigor but they even excelled the plants that were continuously supplied with water from the start until maturity. The yield of straw also dropped materially in cultures in which the water supply was cut off for 17, 24 or 31 days. The straw of the plants that did not revive when water was supplied to the soil was not collected (table 5).

The yield of grain was greatest in culture II, in which the plants were deprived of the normal supply of water for 10 days. In this culture, the yield of grain was 80 per cent more than that from the control (table 5).

Lowland set. The height of the plants in culture II of this set was 12 per cent higher than that of the control. The plants from the other cultures deprived of water for a period longer than 10 days were shorter than those that received water continuously (control) or were deprived of it for only ten days (table 5).

The effects on the yield of straw and grain were similar to those on growth in height. The weight of straw produced by culture II was 37 per cent more than that of the control. The control, however, produced more straw than any of the cultures that were deprived of the usual amount of water for a period of not less than 17 days.

The weight of grain produced by culture II was 44 per cent higher than that of the control; that of the culture III, 10 per cent higher; and that of cultures IV and of V, lower.

As in the upland set, the cultures from the lowland set that were deprived of the usual supply of water for a period of not less than 38 days all died; none revived when water was supplied again.

Straw and grain from second planting

As shown in tables 3 and 4, the results obtained from the duplicate cultures are very much alike. The averages of these results are shown in table 5.

The upland set. The average heights of the plants at harvest (see table 5) were different. The results indicate also that the methods of watering had material influence on the growth in height of the plants in the different cultures. The control plants, which received a continuous supply of

water, differed in height from those which were deprived of the usual amount of water for a period of 5 days, 10 days and 15 days by 3, 17, and 7 per cent, respectively, in favor of the last three cultures. The cultures whose usual water supply was withheld for 20 and 25 days produced plants which, in height, were less than those of the control by 8 per cent and 23 per cent, respectively. The effect of the amount of water supplied to the plant was also exhibited by the yield of straw. In culture II in which the plants 30 days old were deprived of water for 5 days and in culture III for 10 days, the weight of the straw produced was 6 per cent and 34 per cent, respectively, above that of the control plants. The plants of the cultures deprived of usual water for 15, 20, and 25 days produced weight of straw below that of the control plants.

The yield of grain was also affected by the methods of supplying the water in the same manner that growth in height and the yield of straw were affected. The plants in cultures II and III produced weight of grain 58 per cent and 102 per cent, respectively, greater than that of the control; while cultures IV, V, and VI produced weight of grain less than that obtained from the control plants.

Lowland set. The effects produced by the methods of supplying the water to the plants in the lowland set were similar to those obtained from the upland set. The height of the plants in cultures II and III were, respectively, 3 per cent and 14 per cent more than that of the control plants; while in the rest of the cultures the height was less. The good and the bad effects of this method of supplying the water were also exhibited by these cultures in the yield of straw and grain. The weight of straw produced by culture II was 9 per cent, that of culture III, 32 per cent higher than that of the control plants; while the weight from the rest of the cultures was in each case less than that of the control. The grain produced by culture II was 7 per cent and that of culture III, 37 per cent higher than that produced by the control plants. The rest of the cultures, that is, those that were deprived of the usual supply of water for a period of not less than 15 days either failed to revive when water was again supplied to the pots, or revived somewhat, only to produce much less grain than was produced by the control cultures.

Number of days to maturity

As shown in tables 1 to 4 inclusive, the number of days from the day the seeds were sown in the pots to complete maturity of the grain which was produced by the plants varied considerably in different cultures. However, withholding water for five to ten days did not at all change the length of period to maturity as compared with the control. But, as the reduction of the water supply was much prolonged before water was again supplied, the period of development of the plant was also greatly prolonged; in no case should the rice plants 30 or 40 days old be deprived of water for 35 days, as this treatment always proved fatal to the plants.

Effects of treatment upon the upland and lowland rice compared

It might be expected that the upland rice would endure the lack of sufficient moisture in the soil longer than the lowland rice. However, the results of this investigation (see table 5) do not seem to show any material difference; the upland and lowland rice exhibited equal response to lack of moisture in the soil. The data in table 5 show that both the lowland and the upland rice, 30 or 40 days old, when deprived of water longer than 31 days, failed to revive even when water was again supplied in sufficient amount. Moreover, as discussed elsewhere in this report, the plants in both varieties that were deprived of the usual supply of water for a period of five or ten days, produced better results than those produced by the control, in which water was supplied continuously. It is, therefore, quite evident that upon the upland and lowland rice the effects of the treatment were alike.

SUMMARY AND CONCLUSIONS

1. The rice plants in pots, 30 or 40 days old, that were deprived of sufficient water for a period not longer than 15 days, when again supplied with water gave better results, under the criteria of height and yield of straw and grain, than those which were continuously supplied with water from the start to maturity.

2. Although the plants, 30 or 40 days old, that had been deprived of the usual supply of water for 17 to 25 days survived the treatment when again supplied regularly with water till maturity, their yields of straw and of grain were much less than those obtained from the control plants, which were supplied with water continuously.

3. The plants, 30 or 40 days old, from the cultures in which the usual supply was cut off for a period of not less than 38 days, died.

4. Withholding water for 5 to 10 days did not alter the length of period to maturity of the rice plants, as compared with the control in which water was supplied regularly until maturity.

5. The rice plants, 30 or 40 days old, deprived of water for 35 days or more, failed to revive although they were again supplied with sufficient water.

6. The effects upon both the upland and the lowland varieties of rice used, of withholding water from the pots, were quite similar.

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TABLE 1

Showing data obtained from rice cultures in which the seeds were sown on June 18, 1927, and the young plants were allowed to develop normally for 40 days or until July 28, 1927. Thence, except the control, the watering was stopped but was resumed after a certain number of days as shown in the table

Inintiw (upland rice)

CUL- TURES IN DUPLI- CATES	INITIAL DATA			RESULTS OF EXPERIMENTS				
	Number of days water was not sup- plied to the plants	Moisture content of soil before water was supplied	Average height of plants at the time water was withheld	Average height of plants at har- vest	Average increase in height from the time water was with- held until harvest	Air dry weight		Number of days to maturity
						Straw	Grain ^a	
Ia	Control	per cent	cm. 45.43	cm. 88.6	cm. 43.2	grams 15.7	grams 4.2	117
Ib			41.50	84.1	42.6	13.8	3.8	
IIa	10	b	46.33	101.1	54.7	21.2	8.2	117
IIb			43.60	96.7	55.1	18.4	6.2	
IIIa	17	19	45.00	78.3	33.3	11.9	3.3	130
IIIb		17	42.40	75.3	32.9	9.3	2.6	
IVa	24	16	48.83	62.5	13.6	7.9	2.3	144
IVb		14	43.10	59.8	16.7	5.9	1.8	
Va	31	15	45.33	59.2	13.8	6.3	2.1	144
Vb		13	47.50	56.6	9.1	5.5	1.6	
VIa	38		40.80	Dead				
VIb			44.30					
VIIa	45		45.23	Dead				
VIIb			41.23					
VIIIa	52		42.50	Dead				
VIIIb			43.10					
IXa	59		44.00	Dead				
IXb			46.50					
Xa	66		43.46	Dead				
Xb			43.83					
XIa	73		45.83	Dead				
XIb			42.33					
XIIa			41.53	Dead				
XIIb			44.53					

^a Empty and full grains were weighed together.

^b Moisture content of the soil not determined.

TABLE 2

Showing data obtained from rice cultures in which the seeds were sown on June 18, 1927, and the young plants were allowed to develop normally for 40 days or until July 28, 1927. Thence, except the control, the watering was stopped but was resumed after a certain number of days as shown in the table

Macan Kumpol (lowland rice)

CULTURES IN DUPLICATES	INITIAL DATA			RESULTS OF EXPERIMENTS				
	Number of days water was not supplied to the plants	Moisture content of soil before water was supplied	Average height of plants at the time water was withheld	Average height of plants at harvest	Average increase in height from the time water was withheld until harvest	Air dry weight		Number of days to maturity
						Straw	Grain ^a	
Ia	Control	per cent	cm. 44.33	cm. 75.83	cm. 31.50	grams 13.2	grams 2.7	135
Ib			40.43	91.90	31.47	11.8	2.5	
IIa	10	b	46.43	92.06	45.63	19.0	4.2	135
IIb			43.43	72.70	29.27	15.2	3.3	
IIIa	17	19	45.46	67.53	22.07	10.0	3.5	148
IIIb		18	40.53	61.50	20.97	8.1	2.2	
IVa	24	16	47.26	64.36	17.10	7.7	2.8	163
IVb		16	44.03	60.46	16.43	6.5	1.9	
Va	31	14	45.00	69.96	15.96	6.7	1.8	163
Vb		13	41.33	60.26	18.93	5.9	0.9	
VIa	38		42.83	Dead				
VIb			41.76					
VIIa	45		41.66	Dead				
VIIb			43.53					
VIIIa	52		44.33	Dead				
VIIIb			40.80					
IXa	59		42.56	Dead				
IXb			40.53					
Xa	66		40.30	Dead				
Xb			38.76					
XIa	73		43.20	Dead				
XIb			46.16					
XIIa	80		41.13	Dead				
XIIb			49.16					

^a Empty and full grains were weighed together.

^b Moisture content of the soil not determined.

TABLE 3

Showing data obtained from rice cultures in which the seeds were sown on July 17, 1927, and the young plants were allowed to develop normally for 30 days or until August 16, 1927. Thence, except the control, the watering was stopped but was resumed after a certain number of days as shown in the table

Inindiw (upland rice)

CULTURES IN DUPLICATES	INITIAL DATA			RESULTS OF EXPERIMENTS				
	Number of days water was not supplied to the plants	Moisture content of soil before water was supplied	Average height of plants at the time water was withheld	Average height of plants at harvest	Average increase in height from the time water was withheld until harvest	Air dry weight		Number of days to maturity
						Straw	Grain ^a	
Ia	Control	per cent	cm. 33.66	cm. 78.56	cm. 44.90	grams 10.3	grams 3.4	114
Ib			28.93	70.46	41.53	8.6	3.2	
IIa	5	b	34.23	79.36	45.13	10.7	5.8	114
IIb			32.70	74.26	41.56	9.4	4.6	
IIIa	10	32	40.50	92.26	51.76	14.2	7.8	114
IIIb		28	34.26	82.50	48.24	11.2	5.5	
IVa	15	18	33.50	80.56	47.06	10.2	3.4	129
IVb		17	39.76	78.40	38.64	7.8	2.7	
Va	20	15	34.36	71.33	36.97	8.2	1.8	142
Vb		15	29.30	65.60	36.30	6.6	1.5	
VIa	25	13	32.36	59.66	27.30	5.2	1.5	142
VIb		13	30.53	55.40	24.87	4.4	0.8	
VIIa	30		33.10	Dead				
VIIb			35.56					
VIIIa	35		33.70	Dead				
VIIIb			35.10					
IXa	40		34.06	Dead				
IXb			35.73					
Xa	45		34.33	Dead				
Xb			30.10					
XIa	50		35.30	Dead				
XIb			36.06					
XIIa	55		38.13	Dead				
XIIb			33.96					

^a Empty and full grains were weighed together.

^b Moisture content of the soil not determined.

TABLE 4

Showing data obtained from rice cultures in which the seeds were sown on July 17, 1927, and the young plants were allowed to develop normally for 30 days or until August 16, 1927. Thence, except the control, the watering was stopped but was resumed after a certain number of days as shown in the table

Macan Kumpol (lowland rice)

CULTURES IN DUPLICATES	INITIAL DATA			RESULTS OF EXPERIMENTS				
	Number of days water was not supplied to the plants	Moisture content of soil before water was supplied	Average height of plants at the time water was withheld	Average height of plants at harvest	Average increase height in from the time water was withheld until harvest	Air dry weight		Number of days to maturity
						Straw	Grain ^a	
Ia	Control	per cent	cm.	cm.	cm.	grams	grams	131
Ib			36.16	80.40	44.24	16.1	4.8	
IIa	5	b	32.73	83.40	50.67	18.3	5.2	131
IIb			38.13	80.46	42.33	13.9	3.6	
IIIa	10	34	36.56	95.26	58.70	22.0	7.3	131
IIIb		30	35.30	85.36	50.06	16.9	4.1	
IVa	15	19	33.56	75.36	41.80	9.5	2.7	148
IVb		17	33.50	68.30	34.80	7.7	2.2	
Va	20	16	32.60	64.43	31.83	8.6	2.5	159
Vb		15	37.00	65.46	28.46	7.2	1.9	
VIa	25	15	38.86	61.96	23.10	6.6	1.5	159
VIb		14	40.53	60.36	19.83	6.1	1.5	
VIIa	30		34.10	Dead				
VIIb			34.96					
VIIIa	35		31.53	Dead				
VIIIb			32.43					
IXa	40		31.86	Dead				
IXb			32.50					
Xa	45		34.40	Dead				
Xb			32.50					
XIa	50		34.36	Dead				
XIb			37.00					
XIIa	55		30.90	Dead				
XIIb			32.10					

^a Empty and full grains were weighed together.

^b Moisture content of the soil not determined.

As expressed in "relative values" a

SECOND PLANTING, JULY 17, 1927

er rs ot ed ol	Inintiw (upland rice)			Macan Kumpol (lowland rice)		
	Height of plants at harvest	Air dry weight of straw	Air dry weight of grain	Height of plants at harvest	Air dry weight of straw	Air dry weight of grain
	100	100	100	100	100	100
	(74.5 cm.)	(9.45 grams)	(3.3 grams)	(79.4 cm.)	(14.75 grams)	(4.15 grams)
	103	106	158	103	109	107
	117	134	202	114	132	137
	107	95	92	91	58	59
	92	78	50	82	54	53
	77	58	35	77	43	36
	Dead			Dead		
	Dead			Dead		
	Dead			Dead		
	Dead			Dead		
	Dead			Dead		
	Dead			Dead		

PLOWING UNDER LEGUMES BY THE USE OF SINGLE-ANIMAL PLOWS¹

CHARAS S. SUNDARASINHA

INTRODUCTION

One reason green manuring is not a usual practice in the Philippines, and possibly in other tropical countries also is that most of the farmers cannot afford to buy expensive implements with which to plow under green vegetation effectively. Another reason is that some farmers do not know the value of turning under green manures. The aim of the present work was to find a way by which legumes or green trash can be plowed under effectively with the single-animal native plow and cutter.

The work was performed from June 1927, to February, 1928, in an assigned lot adjacent to the railroad line in the Experiment Station of the College of Agriculture

MATERIALS AND METHODS

Description of implements

Roller cutter. This implement was recently devised by Professor M. B. Raymundo of the Agronomy Department. It consists of six circular steel disks each 32 centimeters in diameter and 3 millimeters thick, with sharp edges. These disks are mounted $15\frac{1}{2}$ centimeters apart on an iron axle 3 centimeters in diameter. A pair of bamboo shafts are attached, one to each end of the axle; to the other ends of the shafts a wooden yoke is fastened by tying.

Bolo cutter. This device consists of five bolo blades, or working knives inserted 10 centimeters apart in slots made in a thick wooden rectangular plank $65 \times 40 \times 6$ centimeters in size. The blades are held in place by means of wooden wedges.

Native plow. In this plow the moldboard, of cast iron, is 30 centimeters in length. The share, also of cast iron, is 30 centimeters along the median line from vertex to the base. The beam is made of wood and is 170 centimeters in length. The landside is 56 centimeters in length. The handle is made of wood.

The average cut is about 15 centimeters. The average depth is about 10 centimeters. There is practically no adjustment as to width of cut and very little as to depth.

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For purposes of comparison the following data are given:

Chattanooga Reversible Disk Sulky Plow (Standard)

Disk—50.8 centimeters in diameter.

Average cut—30 centimeters.

Average depth—15 centimeters.

John Deer Prairie Queen Breaker Plow (Standard)

Average cut—30 centimeters.

Average depth—15 to 18 centimeters.

Chattanooga Stubble Plow

Average cut—30 centimeters.

Average depth—15 to 18 centimeters.

Luzon Lagio-single-animal-steel Plow

Average cut—15 centimeters.

Average depth—10 centimeters.

Description of the legumes used

The legumes used in the study were New Era cowpea, Ami soybean, and mungo.

Mungo (Phaseolus mungo). Mungo was used to represent the dwarf type of legumes. It has a thinner growth and finer texture than cowpeas or soybean. Mungo, according to Sornay (1916), is upstanding in character, ranging from 50 centimeters to one meter in height. The leaves are similar to those of common beans and are hairy and wrinkled. The yellowish green flowers arise in pairs at the extremity of the common peduncle which springs from the leaf axils and rises above it.

At the time this plant was turned under its height was about 85 centimeters and the flowers were beginning to open. Mungo grown during rainy season produces an abundance of vegetative parts but seldom any pods. As a green manure crop, according to Sornay (1916), it is a fast grower and within a period of one month it can be plowed under.

New Era cowpea (Vigna sinensis). The cowpea was used to represent the viny legumes. It grows best in warm climates. In the early part of its growth, it is more or less erect, but as it approaches maturity it tends to lodge. The characteristics of New Era cowpea, according to Morse (1924), are: half bushy, prolific; pods held high; seeds buff, thickly and evenly speckled with blue. Cowpea, according to the same author, has been used as a soil renovator more than any other legume because it can be grown easily on almost any kind of land, provided it is not too wet. The crop when used as green manure is beneficial. Its beneficial effects last two or three seasons if it is followed by such crops as corn, cotton or small grains.

Cowpea planted during the rainy seasons tends to produce vine rather than its usual bushy characteristics and has a tendency to entwine forming a "mat". At the time the cowpea used in this experiment was plowed under, the "mat" was about 45 centimeters thick.

Ami soybean (Glycine hispida). Soybean was used in this experiment to represent the woody legume. According to Evans and Fowlds (1921), it is erect, ranging from 30 centimeters to one meter in height. The stem

is hairy. The leaves are trifoliate; flowers are abundant, borne in clusters from the axils of the leaves.

At the time the soybean that was used in this experiment was plowed under, the average height was about 90 centimeters.

Description of the field used

The condition of the field during the experiment was fairly uniform. The soil is sandy loam, mellow, friable, has plenty of humus. It is best for plowing when it can be molded by hand and crumbled even with a slight pressure.

Procedure followed

The field was prepared by thorough plowing and harrowing. It was then divided into three equal lots, each 83.0×60.4 meters. On the first lot, mungo was broadcasted; on the second lot, cowpea; and on the third lot, soybean. After planting, the whole field was harrowed to cover the seeds.

A few days later, when the seeds began to sprout, the stand of each legume was taken; the result is recorded in table 2. This record was made to show that the stand was about average.

When the field was in the right condition for plowing, it was divided lengthwise into seven equal lots, each 11.8×181.2 meters, so that the three representative legumes would be included in each lot. The reason for this was that the same operation could be carried on each legume at the same time.

In each trial, the implements used were drawn across the field lengthwise, using a bullock as motive power.

The effects of the different implements were noted and recorded and photographs (not presented in this paper) were taken at the time to corroborate and clarify the written record. The different treatments on each lot are tabulated in table 3.

DISCUSSION OF RESULTS

The Chattanooga stubble plow could not turn under legumes effectively because the three bullocks which were used as motive power were not fast enough to throw the furrow slice over; there was a tendency for it to roll back to its original position. It was noted that if the stubble plow is drawn by a tractor, the furrow slice turns over well. Hence, speed is an important factor in the turning over of the furrow slice. The ideal speed for a tractor to draw a plow was found to be about $4\frac{1}{2}$ kilometers an hour. The speed of the bullock varies; according to Teodoro (1925), it varies from 0.8 to 2.0 kilometers an hour. For this reason a good turning under of legumes or trash with the stubble plow cannot be expected when it is drawn by bullocks. The same condition was found to be true with J. D. Prairie Queen Breaker plow.

The reversible disk plow, drawn by three bullocks, excelled in effectiveness both the J. D. Prairie Queen Breaker plow and the Chattanooga stubble plow. This superiority may be attributed to the fact that the make-up of the disk plow renders a possible lighter draft than that of the Chattanooga stubble plow or the J. D. Prairie Queen Breaker plow, both of which are moldboard plows. This difference in make-up may make it possible for the bullocks to pull the plow at such a speed that it will turn under effectively trash or legumes.

The Luzon Lagio plow was not effective in the turning under of trash or legumes. This may be attributed to several factors. One is that its moldboard is more like that of a stubble plow than of a breaker plow, though it serves as a dual purpose plow or mid-way between a stubble plow and a breaker plow. Furthermore, its share is of chilled steel and has the tendency to scour. Also, it is heavier than the native plow, consequently, a bullock cannot pull it fast enough to make the act of turning under of legumes or trash effective. According to Teodoro (1925), with the Luzon Lagio plow the furrow bottom cannot be cut entirely off while plowing, and a further defect is its poor work in turning a furrow slice which often tends to roll back to its original position. Trials were made with and without the combination of the roller cutter, but the results were far from being satisfactory. The native plow not only is light in itself, but is lighter in draft than the Luzon Lagio plow because it is made up of lighter materials, mostly wood; the only heavy part is the plow bottom which is made of cast steel. It looks like a stubble plow.

Philippine farmers prefer the native plow to the Luzon Lagio plow because the plow is assembled in the locality where it is used; thus proper adjustment is made to fit the soil conditions and quality of work to be done (Teodoro, 1925).

In the portions of the field that were treated with the native plow without any previous treatment, much of the legumes was left uncovered. But in the portions which were treated once with roller cutter and then turned under with the native plow, the legumes were partly covered, that is, a little better than where the legumes were plowed under without any previous treatment.

The portions of the lots that were treated first with the bolo cutter and then turned under with the native plow were worse than when the roller cutter was used once. For the bolo cutter has the tendency to roll up the legumes in piles, making it hard for the native plow to turn them under.

The treatment that proved to be the best among the ones tried was the using of the roller cutter twice and then turning under with the native plow. Using the cutter twice, the legumes were cut into smaller parts, theoretically, three inches, but the plants were laid at various angles from the direction of the roller cutter, so, obviously, the cut portions will vary in length. How-

ever, this procedure proved nearly, if not quite, as effective as when the legumes were turned under with the reversible disk plow.

The roller cutter not only cuts the legumes but also cuts into the soil to a depth of about five to seven centimeters, thus facilitating plowing, because the surface of the soil breaks up more easily. The roller cutter will cut out trash or stems not more than two centimeters in diameter.

In cutting the legumes, a sack of sand added to the weight of the driver increases the efficiency of the sharp edges of the disk of the roller cutter. The approximate weight of the driver and the sack of sand in this experiment was 100 kilograms. In case the load was too heavy for one animal, a hitch is provided for two animals. However, only one animal was used throughout this test.

Mungo could be turned under with little effort, for it is erect, less bushy and has tender stems as compared with the soybean and cowpea. Besides the fresh weight of top per square meter was lower than that of cowpea, being about two kilograms per square meter (see table 2).

The cowpea is a viny plant. It tends to lodge on the ground as it approaches maturity. The plowing under of this portion of the field was hard, because of the tendency of the cowpea to form a "mat". Also it is the heaviest producer of all the legumes used, having about three kilograms of tops to a square meter (see table 2). This is another reason it was hard to plow under.

Though soybean producing about two kilograms of tops per square meter (see table 2) has the upstanding character and is, at the same age, the tallest of the legumes used, nevertheless the plowing under of this legume was easier than with cowpea but a little harder than with mungo.

As to comparative costs in plowing under legumes, the use of the roller cutter twice and the native plow is cheaper to use than the reversible disk plow. The native plow with the roller cutter cost ₱8.44 to the hectare, while the reversible disk plow cost somewhere around ₱12 to the hectare. However, the native plow does not turn under the legumes as well as the reversible disk plow, but it answers the purpose. (See table 4.)

SUMMARY OF CONCLUSIONS

1. The turning under of legumes by using the combination of the roller cutter passed twice and the native plow proved to be nearly as effective as the reversible disk plow.

2. The combination of a roller cutter and a native plow is not an expensive operation, hence, it is recommended for a farmer whose capital is small.

3. The handling of a roller cutter in combination with a native plow is so simple that no experience is necessary before using it. This feature should encourage farmers to practice green manuring on their farms.

4. A roller cutter can be made at a moderate price in any local blacksmith shop by supplying necessary materials.

5. Since the roller cutter can cut any size of trash that is less than two centimeters, provided there is a proper load on it, any kind of legumes under this treatment will be satisfactory as a cover crop.

RECOMMENDATIONS

1. For satisfactory use of the roller cutter it is suggested that in case the trash to be plowed under is heavy and thick, more weight should be put on top of the cutter.

2. If one animal cannot pull the roller cutter properly loaded for satisfactory work, it is advisable that two animals be used, as the implement is always provided with an extra hitch in case of emergency.

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TABLE 1

Cost per hectare of preparation of land and of broadcasting seeds

DATE	OPERATION	HOURS TO A HECTARE	COST OF OPERATION INCLUDING DEPRECIATION AND INTEREST
June 4	Plowing.....	27.0	pesos 6.06 ^a
June 8	Harrowing after plowing.....	13.5	3.01
June 9	Harrowing after plowing.....		
June 10	Broadcasting seeds.....	4.0	0.44
June 10	Harrowing to cover seeds after broadcasting.....	13.5	3.01
	Total.....	58.00	12.52

^a Depreciation per day = $\frac{\text{Cost of the implement}}{\text{Maximum number of years that it will last} \times \text{maximum number of days used in one year.}}$

Interest per day = $\frac{\text{Cost of the implement} \times \text{rate per cent interest per year}}{\text{Maximum number of days used in one year}}$

An example, Native plow:

$\text{P}10.00 \times 3 \text{ days} = \text{P}0.039 \text{ depreciation for 3 days (27 hours)}$
 $5 \text{ years} \times 150 \text{ days}$
 $\text{P}10.00 \times 10 \text{ per cent} \times 3 \text{ days} = \text{P}0.018 \text{ interest for 3 days (27 hours)}$
 150 days

$\frac{27 \text{ hours}}{9 \text{ hours (one day)}} \times \text{P}1.00 \text{ (per day)} = \text{P}3.00 \text{ cost of man's labor}$

$\frac{27 \text{ hours}}{9 \text{ hours (one day)}} \times \text{P}1.00 \text{ (per day)} = \text{P}3.00 \text{ cost of man's labor}$

Total cost of operation per hectare including the depreciation and the interest is = $\text{P}0.039 + \text{P}0.018 + \text{P}3.00 + \text{P}3.00 = \text{P}6.06$.

According to Maligaya (1924) "Ten per cent interest per annum is the rate of interest at the bank for the farmers with good security".

According to the same author, "The native plow will last for five years provided that the bottom piece including the share is changed once".

Other depreciation rates and interests of different implements were obtained from the Division of Farm Management, and were computed in the same manner.

TABLE 2

Showing area planted, amount of seed used, average stand of plants, average fresh weight of tops, cost of seed of the three legumes used

LEGUMES USED	AREA BROADCASTED	AMOUNT OF SEED USED	AVERAGE STAND PER SQ. M. PLANTS	AVERAGE FRESH WEIGHT OF TOPS PER SQ. M.	AVERAGE COST OF SEED PER LITER	COST OF SEED PLANTED
	<i>sq. m.</i>	<i>liters</i>		<i>kgm.</i>	<i>pesos</i>	<i>pesos</i>
Mungo.....	5013.2	21	35.3	1.9	0.13 1/3	2.80
Cowpea.....	5013.2	21	26.3	2.9	0.13 1/3	2.80
Soybean.....	5013.2	21	15.3	1.8	0.15	3.15

TABLE 3
Treatment on each lot

LOT NO.	IMPLEMENTS EMPLOYED
I	Native plow Native plow in combination with bolo-cutter Native plow in combination with roller-cutter (passing once) Luzon Lagio plow Chattanooga stubble plow J. D. Prairie Queen Breaker plow Reversible disk plow
II	Native plow in combination with bolo-cutter Native plow in combination with roller-cutter (passing once) Native plow in combination with roller-cutter (passing twice) Luzon Lagio plow in combination with roller-cutter (passing once) Luzon Lagio plow in combination with roller-cutter (passing twice) Chattanooga stubble plow J. D. Prairie Queen Breaker plow Reversible disk plow
III	Native plow in combination with roller-cutter (passing once) Native plow in combination with roller-cutter (passing twice) Luzon Lagio plow in combination with roller-cutter (passing twice) Reversible disk plow J. D. Prairie Queen Breaker plow Chattanooga stubble plow
IV	Native plow in combination with roller-cutter (passing once) Native plow in combination with roller-cutter (passing twice) Reversible disk plow J. D. Prairie Queen Breaker plow Chattanooga stubble plow
V	Native plow in combination with roller-cutter (passing once) Native plow in combination with roller-cutter (passing twice) Reversible disk plow Chattanooga stubble plow
VI	Native plow in combination with roller-cutter (passing once) Native plow in combination with roller-cutter (passing twice) Reversible disk plow
VII	Native plow in combination with roller-cutter (passing twice) Reversible disk plow

TABLE 4

Cost of operation per hectare of different implements

IMPLEMENTS USED	KIND OF OPERATION	COST OF OPERATION INCLUDING DEPRECIATION AND INTEREST
		<i>pesos</i>
Native plow.....	plowing	6.06
Bolo-cutter.....	cutting	2.23
Roller-cutter.....	cutting	1.21
Reversible disk plow.....	plowing	12.14
J. D. Prairie Queen Breaker plow.....	plowing	12.78
Chattanooga Stubble plow.....	plowing	12.58
Luzon Lagio plow.....	plowing	6.05

DOCTOR MANUEL L. ROXAS: AN APPRECIATION¹

The holding of good men in the faculty in competition with commercial enterprises which are able to pay enormous salaries is one of the biggest problems of administration of a college which aims to maintain first class standards. This time it is Dr. M. L. Roxas, Professor and Head of the Department of Agricultural Chemistry, who has left us to accept full time employment with the Philippine Sugar Association. He will be in charge of the experimental work for the association in Luzon, a position which he has been holding on part time for the last three years. Doctor Roxas felt sufficiently heroic to shoulder the work of two positions, each one of which was large enough for one big man to carry, but the overload was too much to bear indefinitely.

Doctor Roxas was among the very first students of the College and stood first among its first three graduates. He has been connected with the institution since its foundation. He was among that small group who helped clear the field of material and moral obstacles and made possible the building of the superstructure of the College. When the founders of this institution were told that the better class of Filipinos could not be attracted to an agricultural course, they pointed to Doctor Roxas and to a few others as shining examples of the kind of material that composed the student body of the new College.

Doctor Roxas paved the way for many significant events in the College. He was the first student to be appointed as an assistant and later as a pensionado of the College he was the first among its alumni to receive the doctorate degree from an American university. We shall long remember Doctor Roxas on the Campus for his many sterling qualities as a man and as a scientist, but of his many splendid services for the cause of the College and the student body, the Sugar Technology course and the Student Mess stand out as monuments to his initiative and enterprise and to his interest in the welfare of the youth of this country.

When the future shall have removed the material difficulties which beset an idealist with a family to raise from following his natural inclination, we shall hope to have Doctor Roxas once more with us with the added value of the prestige and experience which are bound to come to him from his present connections.

We wish him every kind of good luck.

B. M. GONZALEZ,
Acting Dean, College of Agriculture.

¹General Contribution from the College of Agriculture No. 206.

NOTE: THE CHARLES FULLER BAKER ENTOMOLOGICAL COLLECTION

MUSEUM RECEIVES GREAT COLLECTION OF MALAY INSECTS

Enriched by nearly a third of a million specimens gathered together by Dean Baker, of University of the Philippines—collection largest of kind ever assembled

The United States National Museum has been enriched by the acquisition of what is undoubtedly the greatest collection of Malayan insects ever assembled, a collection brought together by Charles F. Baker, who was dean of the college of agriculture of the University of the Philippines in the period 1917-1927, and bequeathed by him to the Museum.

The collection contains specimens estimated by Dean Baker himself to number 250,000, but later estimated at more nearly 300,000 by R. A. Cushman, an associate entomologist of the Bureau of Entomology, who was assigned to task of going to the Philippines and packing it and bringing to the National Museum. It is contained in 1,417 standard Schmitt boxes 13 by 9 inches in size, distributed by orders as follows: Coleoptera 697, Hymenoptera 207, Homoptera 208, Hemiptera 115, Lepidoptera 125, Orthoptera 96, Diptera 40, and the remaining 19 divided among the smaller orders. The number of boxes devoted to family units varies from a fraction of 1 to 122, and there are many types and hundreds of species new to the national collection. Besides these specimens the collection includes a card catalogue, approximately 100,000 cards, all written by Dean Baker's hand, of all published references to Malayan Homoptera. To the uninitiated these figures mean little, but to one who has worked with insects and with cataloguing they mean an appalling amount of labor, says Mr. Cushman.

After having been appointed honorary assistant custodian of Hymenoptera by the National Museum, Mr. Cushman left Washington October 2 for the Philippines. It required considerable time to pack the collection, and in this work Mr. Cushman had the hearty cooperation of the college of agriculture, the Quartermaster Corps of the Army, and many private citizens. The boxes containing the collection were conveyed from Los Baños to Manila by barge and tug furnished by the quartermaster department, and on February 15 Mr. Cushman sailed with the collection on board the transport *Thomas*, bound for San Francisco. From San Francisco the collection was transshipped via the Panama Canal to New York, where it arrived April 7 on the transport *Cambrai*. Three days later it was transferred to a freight car, on which it arrived in Washington April 12, and on April 16 and 17 it was unpacked and distributed by orders to the various specialists in the Museum. The collection arrived in excellent condition, with a negligible amount of breakage. Some idea of its size may be gained from the fact that an aggregate of about 250 feet of shelf room was required for its temporary storage.

—*The Official Record* (U. S. Dept. Agric.)

COLLECTION OF BUGS RECEIVED

Carload of Maylayan Insects Left by Dr. Baker

Washington, May 6. (Exclusive)—A monument to the leisure hours of a great scientist in the shape of a carload of insect specimens has been received at the Smithsonian Institution. They came from the Philippines by United States Army transport via the Panama Canal. They represent the most extensive and varied collection of insects from the whole Malayan Archipelago extant. They were collected under the inspiration of the late Charles Fuller Baker, dean of the college of agriculture, University of the Philippines, and pinned and labeled entirely by his own hands when he was off duty.

The number of specimens is estimated at 300,000, while there are perhaps 50,000 more in the hands of the 115 specialists scattered over the world to whom Dean Baker had sent lots for identification before he died. He spent fifteen years of spare-time labor in making this collection.

Dr. L. O. Howard, former chief of the Bureau of Entomology, has said of Dean Baker: "I cannot believe that any other man will ever do as much in entomological lines."

Another authority describes Baker as "the greatest collector of insects that this generation has known and one of the best field botanists, having a wide acquaintance with both flowering plants and fungi."

The collection includes representatives of nearly all orders. Baker gathered them by personal collection, by sending out students and others to collect for him and by exchange. Areas from which specimens came stretch from Penang, Straits Settlements, to the Philippines, and there are representatives from Japan, China, Formosa, New Guinea and Australia. Nothing like this collection has ever been made and it is of immense scientific and economic importance. It includes an unknown quantity of type specimens already described and many new species yet to be described.

Because of the humidity of the Philippine climate, the danger from pests and from fire, it would have been unwise to leave the collection in the islands. Incorporated with the national collection under Smithsonian, it will be well taken care of and in addition will be available to a much greater number of specialists for study than it would be anywhere else. It was his recognition of these facts that led Dean Baker to will his collection to the Smithsonian. The task of incorporation will require years and much greater funds than are now available to the Smithsonian Institution.

Dean Baker stands out as one of the most remarkable naturalists in history. It is said of him that no other man who ever lived was responsible for the discovery of nearly as many new species as he. Aside from his energy which was phenomenal, he was the keenest of observers and found new species of plants and animals where others found nothing—a new species of moss in a chink of the wall of the botany laboratory at Stanford, a new poppy on the campus, a new flea on a squirrel in Nevada. As this indicates, also, his interests were as wide as natural history. As a teacher he seems to have had few equals. He wore himself out at the age of 55 but his achievements would do honor to three men.

The Baker collection was brought to this country by R. A. Cushman of the Bureau of Entomology and honorary assistant custodian of Hymenoptera in the National Museum. Mr. Cushman spent two and a half months preparing the 1400-odd boxes for shipment.

—*Los Angeles Times.*

A REVIEW: "PRACTICAL POULTRY-FARMING"¹

The value of poultry raising as a branch of Philippine agriculture is becoming more and more appreciated, judging by the increase in requests for information on this subject. In the past, most of these requests came from back-lot and from side-line poultry raisers. Recently, however, requests for information about large scale, or commercial poultry raising have been received. Publications on this line, therefore, will be gladly welcomed by those interested in the industry, especially those contemplating raising chickens, whether on a large or on a small scale.

Mr. Hurd², himself a successful poultry farmer and a poultry extension specialist, has written a "practical guide for both large and small poultry-keepers and those interested in starting a poultry enterprise." This book, not only for poultry raisers in the United States, but also in the Philippines, is a very valuable guide; the subject of poultry-farming could not be treated in a more thoroughly practical manner. The best and up-to-the-last minute practices of successful poultrymen, combined with the latest scientific discoveries in poultry feeding and management, written in a popular manner by a practical man, make the book a very useful manual for both large and small scale poultry raisers.

In its first twenty chapters, poultry-farming from A to Z is covered in a practical way. The first seventeen chapters are devoted to the care of poultry and the management of a poultry enterprise. The chapters on culling and selection are especially valuable because, as the author states, "many times success or failure of a poultry enterprise depends on this." The directness and clearness of the discussion of these phases of poultry-farming in this book make the chapters interesting and easy to apply in actual practice. Chapter XVIII gives popular pointers on the diagnosis and the prevention and control of poultry diseases and parasites. The last four chapters of the book are given to the discussion of the care and management of turkeys, guinea fowls and peafowls, ducks, geese and swans, pigeons, and pheasants.

Because local conditions in the Philippines differ widely from those in the temperate countries for which the book was particularly written, some of the recommendations given must be modified or adapted. Local methods of poultry management must necessarily be based on actual conditions existing in the locality, and for this reason a Filipino poultry man should be careful in the application of some of the different practices and methods given in this book. But in spite of the difference in the conditions in the Islands and those in the United States, Mr. Hurd's book will be of useful service to local poultry raisers as application of the scientific principles is the same in both countries. The many illustrations in the book add to its value as a reference book for students of poultry-farming, as well as for those contemplating engaging in poultry raising in this country.

F. M. FRONDA,
Of the Department of Animal Husbandry

¹ General Contribution from the College of Agriculture No. 207.

² Hurd, Louis M. 1928. Practical poultry-farming. xxiii+405 p. 149 fig. New York: The Macmillan Company.

EXTENSION DIVISION NOTES

Prepared by Moises M. Kalaw under the supervision of Prof. Inocencio Elayda

A Graduate's Experience in Clearing Forest Land

Pacifico L. Masibay of the class of 1925 writes from Zaragoza, Nueva Ecija, recounting his farm experience after his graduation. He tells us that in 1927 he bought a twenty-hectare piece of agricultural land. Of that area 12 hectares were a second-growth forest, two hectares in mango orchard and six hectares rice land.

The mango orchard and the rice land gave him little concern as their operation is routine work, although he hopes to introduce later some improvement in the yield of the crops and the management of the farm business. His first concern was to bring the wooded portion under cultivation by the initial process of clearing the forest.

In doing this he employed two methods of clearing. The first operation in clearing the first eight hectares consisted of underbrushing and felling the large trees leaving about half a meter of stump. Subsequently these stumps were grubbed out. Both the logs and the big stumps were piled in a corner, while all the light stuff such as small branches were left on the land and burned when dry. The area thus cleared was planted by *cañgin* method to rice. Mr. Masibay found that in the operation they grubbed out 16,756 stumps varying from 5 centimeters to 80 centimeters in diameter and twice as many smaller stumps. Employing 24 men, the work finished in about a month at a cost of P1,003.

For the remaining four hectares of the forest area he used another method of clearing. After cutting the underbrush the trees were grubbed down to the roots on the side of the trunk opposite the tree inclination. By utilizing the dead weight of the crown, branches, and trunk the trees were felled and uprooted at one operation. This method was much cheaper than the first as it dispensed with the chopping down of the trees and the grubbing out of the stumps. The lopping of the branches, drying, burning, and clearing of the trash and planting the first crop were performed as under the first method. It took a month to finish this work with only five men and at a cost of P170.

Comparing the two methods used in clearing his land, Mr. Masibay concluded that the second method required "less labor, less physical exertion, less time and less capital per unit of area". It is to be presumed that he was induced to use the first method because it is the one commonly practiced in the Islands in clearing a forest land for *cañgin* purposes. In this connection, however, it must be borne in mind that for *cañgin* the stumps

of large trees and the logs are left in place to decay. Generally the effect of a good burning is so complete that most of them are killed and the few that survive are kept shorn of new shoots until they perish and decay. With this practice the first method may prove as economical as the second, except that in the first it is three or more years before the land can be plowed, while as Mr. Masibay cleared it the land can be plowed at once. But there is seldom the necessity for breaking newly cleared land with the plow. The burning process, besides sweetening the soil for plant culture through the destruction of the excess of accumulated organic matter, is known to have practically the same effect in providing the soil with proper aëration as breaking the land with the plow. The cracks formed in the soil as a result of the burning serve as air passages substantially the same as though the ground had been stirred up with farm implements.

However, for his own benefit, what counts in the experiment made by Mr. Masibay is the experience he gained by personally conducting the work and seeing the result of his own plan. He is now in a position to tell that actual experience is the best means of learning a craft, as it gives confidence in one's ability to do work.

Tephrosia Solving a Problem in Coconut Planting

Up to the time of bearing, the most difficult problem coconut growers meet comes three or four years after planting. At this stage the plants have grown to a height which makes the raising of crops between the coconut plants no longer profitable. If a planter is handling two or three hectares it will be possible to clean them even without getting any returns. But when a farmer is handling a plantation of say a hundred hectares he cannot afford to maintain so large an area under cultivation for so long a period without any returns. But it is very necessary that the plantation be kept clean or free from harmful weeds like the cogon. Once a plantation is neglected at this stage and the cogon takes possession the growth of the nuts is retarded by about three years. All coconut growers know this. They know that many coconut plantations have been damaged if not actually destroyed by cogon. How to prevent cogon growing in his plantation has troubled many a coconut grower.

I know of several cases in which the inability to combat this plant caused a great expense to or ruined the planter. An efficient farm manager in a nearby province has failed as a coconut planter and lost a large sum of money just because he was not able to overcome this difficulty. Several years ago he entered into a contract with a rich land owner. The contract was that he would plant for the owner a three-hundred-hectare farm with coconuts. He was to be responsible for all expenses and have all the crops that he could raise from the land while planting the coconuts. The land owner was to loan him the necessary capital. After seven years the land

owner would pay him one peso a coconut tree that he had planted provided that the plantation was in a satisfactory condition.

The manager made good in the first part of the contract. He was able to cover all the 300 hectares with coconuts. But three years after planting the coconuts he met a problem which he was not able to solve and which caused his failure. After three years he could not raise any more crops for the subsistence of his men. He could not afford to have the land plowed or cultivated without getting any returns. But he was required to keep the plantation clean, otherwise the owner would not pay him. He tried his best to fulfill the contract, but the undertaking was too great for him. At last he tried to make the plantation a pasture for farm animals. But the animals proved harmful to the coconuts and this gave good ground for complaint by the landowner. Later, the farmer had to give up and leave the farm to nature. The land virtually became a cogonal between the coconuts. At the end of seven years he submitted the plantation to the landowner, who, naturally was not satisfied with the condition of the plantation and would not pay him the one peso a tree. The manager took the matter to court, but the case was decided in favor of the landowner, except that the manager's debt would be cancelled. But his loss was about 10,000 pesos.

I had a talk with this farm manager recently and he told me that his failure was mainly because he was not able to find a plant, a cover crop, suited for growing in the plantation after the third year. He said that had he known of *Teprosia* at that time he could have prevented his failure as he could have submitted the plantation in a most satisfactory condition. But he knew of no suitable cover crop. He could not use the legumes that are common in the locality as they are annual crops and, besides, the people will gather them for their own use. He said that *Teprosia* is the only plant that could have saved him.

Another farm manager who entered into a contract similar to this one is now facing a similar problem. But this farm manager is trying to make good his contract at any expense. So for the last three years he has been spending large sums keeping the plantation clean, though he knew he was losing. Recently he learned of the use of *Teprosia* in Batangas and recognized that it is the crop that he badly needs and began to plant it. He has so far planted about 28,000 coconut trees and he hopes to cover the area between them with *Teprosia*. He is quite sure of success from results that he saw in Batangas. Were it not for *Teprosia* he would meet the same fate as the manager cited above.

In previous years many cases similar to these two have been known. It is common in a developing coconut district to see the plantation covered with cogon or other obnoxious weeds. In some places cacauate or madre cacao, a kind of leguminous tree, is being used as a cover crop. In some cases it succeeds. But this plant is quite difficult to handle. From results

actually seen there is no doubt of the effectiveness of *Teprosia* as a cover crop for coconuts.

The method of planting *Teprosia* is simple. Prepare the soil as for corn. Make furrows about 80 centimeters apart. Plant the seeds in the same way as mungo. If the cogon or any grass that is to be killed is thick make the planting a little closer. Within six months the *Teprosia* will have grown so tall that no other plants can grow under it. If desired it can be cut to any desirable height.

Developing a Piece of Public Land

In our last Extension Division Notes a brief discussion of land prospecting and selection of site for a farm was given. In personal trips made recently through a public land region in the province of Camarines Sur prospecting for land we experienced the same difficulties as given in our Extension Notes. On two different trips we spent days and days in the interior of the forest, opening our way through it by swamping and blazing our way with the help of a compass. There was quite a number of people in the party. Laborers were employed to carry baggage and provisions and help clear the way. The party camped in the forest when night came. At times the party had to go on a much reduced ration, and at times without any—depending upon the supply secured from the nearest settled community. And for these supplies exorbitant prices were paid. To prospect for land in unopened regions requires pluck and endurance against fatigue and resistance against sickness that may be contracted from exposure, lack of shelter and over-exertion.

But when the question of public land settlement comes up for discussion in the press, in a convention, or official correspondence, the question is usually dismissed by asking: Why do our young men not have the courage to rush to homesteading and occupying our rich agricultural public land which is waiting for energetic hands to convert it into gardens? They do not stop to think of the help that should be extended in this kind of pioneering work before it can be translated into reality, and before people in greater numbers can be induced to venture in such an undertaking. In every case settlers need money to start with not only in developing the land so acquired but also in financing the preliminary work in locating and selecting the site.

In our prospecting work we drifted into places where settlers were already occupying and developing a piece of public land either through homesteading or special permits for *cañgin* camp, or residence. Some of these settlers are residents or natives of the nearest communities and others hail from distant provinces. They all recognize the fact that they had to have the money to start with and a working capital to develop the land until their plantings began to produce harvest to help provide for their daily needs and enable them to save and supplement their initial capital.

The most wide-awake settlers have followed the following procedure in getting possession of a piece of public land.

1. They select the site first and delimit by cutting the boundary lines and keeping them clean on four well marked corners.

2. Filing the application for a homestead entry with the Bureau of Lands when the land in question is declared to be suited for agriculture; or for *caiñgin* or residence or camp permit with the Bureau of Forestry if the land is held under the jurisdiction of this Bureau.

3. In the case of homesteads once the application is approved the applicant enters the land and begins to develop it. He is given five years' time to get the land developed, at the expiration of which when all the legal requisites are complied with, he is issued a Torrens title.

4. In the case of special permits from the Bureau of Forestry he can hold the land only for a certain period of time on condition that he is to use the land only for annual not permanent crops. If the land covered by these special permits is declared agricultural land open for occupancy by proclamation of the Governor General, it can be applied for as homesteads or as purchase from the government, the area for each being amplified to the extent allowed by law—24 hectares for a homestead and 144 hectares for purchase by an individual.

These homesteaders developed their land by the practice of *caiñgin* method of farming. The land is cleared piece by piece, the size of clearing depending upon the resources and co-operative work at the disposal of the settler. Rice and corn are generally planted the first year together with bananas, sweet potatoes, and native garden vegetables for the use of the family. Where coconuts are to be planted if the seedlings have been previously prepared for transplanting, they are set out before the rice is planted. These interplantings continue until the land, with the rotting out of big logs and stumps, is in shape for plowing. In many cases to minimize the expense in weeding, the land is plowed between the rows of coconuts and planted to intercrops until the coconut trees have grown large enough to shade all the area supporting the so-called permanent plantation.

This brief account is not by any means complete, but the value of it lies in that the data have been gathered from actual field pioneering work by coming in touch with the pioneers themselves. And one thing that stands out is that the man who ventures into this kind of an enterprise has to have some initial capital to meet the necessary expenses of locating the site, filing the application for the land, delimiting the land and keeping the boundary lines clean and distinct, watching it and keeping out trespassers, entering the land, clearing and planting and keeping up the plantation, and meeting all the living expenses on a new settlement. This expenditure goes on for the first year unsupplemented with the produce of the intercrops as these come generally the second year of cropping.

EXCHANGE NOTES

George Washington seemed to be passionately fond of trees, shrubs and hedges and records: "I shall begrudge no reasonable expense that will contribute to the improvement and neatness of my farms, for nothing pleases me better than to see them in good order and everything trim, handsome and thriving about them; nothing hurts me more than to find them otherwise."

—*California Cultivator*.

Vegetable leaves and stumps should never be thrown on the ground in the poultry run; some of them may be left to decay, and possibly be the cause of ptomaine poisoning, or of an outbreak of infectious disease. Green stuff, if not chaffed, can be placed in wire-netting baskets and hung up in the pen, and the birds will pull it through the mesh.

—*Journal of Agriculture* (Victoria).

Argentina, one of our chief competitors in the world's agricultural markets, is rapidly growing in importance. In 1927 its agricultural exports were half again as much in value as in 1923. During the last five years 96 per cent of the country's exports were of agricultural products, yet only a small part of the potential tillable land has been brought into cultivation, only eight per cent of the country's total area being in cultivation.

A large portion of the cultivated area is in the hands of comparatively few holders. Most of the holdings average 1,200 acres or more in size. In 1920 about 59 per cent of Argentina's farmers operated only 3½ per cent of its farm lands, while in the United States 59 per cent of our farmers operated 17 per cent of the farm land.

—*The Prairie Farmer* (Illinois).

Roselle is a native of the old world and India. How was it introduced in Europe in 1576 is not understood; however, it is known for certain that it found its way into the Botanic Gardens of England in 1596 from Jamaica. The culinary uses of the plant's calyces were recognized early in the 18th century in the West Indies. The uses of the leaves of the plant were long known to Javanese, as early as 1658. In India it is being grown along with *H. cannabims* chiefly for its fibre, sold as Bimbipatan jute, and the leaves and young tender shoots as vegetable. Roselle has long been cultivated in

Mexico, in parts of Central America and West Indies. It has been reported as an horticultural crop in Australia and in 1898 two factories were reported as working and exporting jam to Europe.

—*Poona Agricultural College Magazine* (India).

A news item is at hand which tells of the work of Dr. William H. Difenbach of the Flower Hospital, New York, in producing female chicks only from hatching eggs that were treated with X-rays. There seems to be no explanation for this result, although one explanation suggested by scientists is that the powerful rays succeeded eventually in destroying the male producing chromosome within the fertilized egg. This sounds like additional proof that the female is hardier than the male.

He has been experimenting along this line for the last 3 years and has produced chicks with marked peculiarities. Exposures to the X-rays up to several hours have produced chicks with deformities, such as the absence of wings.

—*American Poultry Journal*.

One Mid-West farmer found his fields infested with white grubs and cutworms. He put up well-built bird houses, and now says that the white grubs are gone and he has not seen a cutworm for five years.

Another farmer had trouble with tree scale and fruit worms until he attracted summer birds to his orchard. In a few years the pests were gone and his trees produced fine fruit. By building bird-houses, people all over the country have benefited their fields. Even though a little grain or fruit is eaten by the birds, it is small pay for all the good done.

—*The Prairie Farmer* (Illinois).

Reports have it that the first sack of sugar manufactured at Black Hills, South Dakota, was sold for \$1,000 to the Sioux City Stock Yards Company. The "Centralblatt" of Germany calls this "echt Amerikanisch," real American, but adds that it is not a bad scheme and evidently wishes some of their factories could have such an exciting time. Withal, the coming of a sugar factory is worth while magnifying in any state and community because of its lasting benefits to the commonwealth.

—*The Planter and Sugar Manufacturer*.

COLLEGE AND ALUMNI NOTES

Mr. Reginald King, A. B. and M. S., University of California, has been appointed Professor of Sugar Technology. Professor King reported for duty on July 20, 1928.

Mr. Leandro S. Ebro, B. S. '26 and M. S. in M. E. '27, University of California, has been appointed Instructor in Sugar Engineering, effective

June 16, 1928. Before coming to the College, Mr. Ebro was employed in the Philippine Bureau of Public Works.

Dr. Miguel Manresa, U. P. Fellow at University of Wisconsin, writes Dean Gonzalez that he has "satisfactorily completed the final requirements for the doctorate". He will spend some time in eastern United States visiting Washington and important universities. He will return to the Philippines via Suez Canal, spending forty-five days in Europe. He will arrive in the Philippines about the opening of the second semester.

The Los Baños Colleges' Tennis Club was successfully opened July 4, 1928. Tennis enthusiasts from different tennis clubs in Laguna were present. The success of the affair was due to the untiring efforts of the club president, Dr. F. T. Adriano.

Mr. Getulio A. Guanzon, Assistant in Sugar Technology, who has been on accrued leave, reported for duty July 2, 1928.

The Makiling Echo for July presents two valuable papers, "Classification of Public Lands in P. I." and "Railroad Ties for Sugar Centrals" and interesting notes on the forestry work.

The Secretary reports enrollment for the first semester to be 792. There are 23 co-eds this year and 9 foreign students.

SHORT COURSES IN AGRICULTURE

Short Courses in Agriculture, since they were established in the latter part of the 19th century, have made a large contribution to the agriculture of the country [U.S.]. Through them the colleges have been able to increase the earning power and satisfaction of thousands of people who for one reason or another could not take a four year course. In states where short courses have been made an important part of the work of the College of Agriculture short course graduates will be found holding important positions among important leaders. The short courses also have been of much direct help to the colleges in that they have aided in no small measure to establish in the minds of farmers a confidence in these institutions. Dr. Liberty Hyde Bailey, for years dean of the College of Agriculture at Cornell University, some sixteen years ago uttered these significant remarks in the presence of the writer, "Our Short Courses are just beginning. They are like a breath of fresh air in a close room. The short course students bring to Cornell the problems of rural New York in a more significant way than any other group of people. They are a challenge to the best that is in our staff." . . .

Assuming that there is a field for it, [short course], it is an obvious fact that the fundamental factor in determining the ability of any work to succeed is its own character. From this point of view it is our opinion that the short course work must be organized and administered with the following policies in mind. First, that it is a phase of resident teaching, not extension, of sufficient duration and so organized that the student may learn certain methods and practices that may be of immediate value to him on the farm and from which he may also acquire certain fundamental principles that should enable him to analyze and solve for himself many of the problems that will arise in his farming. This work must also indicate to him where he may find help for himself and give him the inspiration and enthusiasm to continue, after leaving college, his study through careful reading. Secondly, the work must be an entity in itself so that when a person comes to the short courses he feels he is a part of the college or university life and his work is considered as important by the college authorities as he, himself, feels it to be. This means that he will come in contact with "Prexy" at least once and the dean several times; that his teachers will be the best instructors on the campus, not the poorest; that his program of study is not suspended or even interrupted because of the exigencies of other activities; and, that there are events, social and otherwise, planned and carried out that will make him feel at home and accord to the institution a loyalty that

will be sustained perhaps to as high a degree as though he had taken a four year course. Third, the course must be based on the needs of the agriculture of the state and the work of the student held to as high standards of attainment as is compatible with their preparation. It is through rather strict adherence to such policies that the short courses in New Jersey have had any degree of success with which they may be credited.

As to how far the Smith Hughes high schools have supplanted the short courses is a matter that involves the study of several questions. The theory behind this work, that is, of having the boy receive his training at home where he may have home influences, be at less expense, conduct a project on the home farm with the practical value that accrues not only to the boy but, perhaps, to the parents and neighbors as well, and be more likely to remain a permanent part of his home community, has a great deal to commend itself in its practical application, and these schools may be expected to render excellent service in the training of young people for the farm. At the same time there are certain factors that still allow splendid opportunity for the short courses. In the first place not all the boys, or even a majority of them, in any rural section enroll in the course in agriculture in the local high school. Some of them, on entering high school have not made up their minds as to what they really want to do and high school is over before they have made a decision. Still others, with farming as their future, feel that the usual high school subjects provide a better training for life and so do not take agriculture. Many of them, even in the agricultural departments, because of various reasons, drop out before their high school course is completed. Among all these groups is a considerable number of boys, who, in their late teens and early twenties, under normal economic conditions, finally decide to engage in farming. As a rule they do not care to return to high school with those younger than themselves and are not ready for college. The short courses at the college provide the opportunity for boys in these groups as well as for those in a great many sections which do not have, or are not near, Smith Hughes Schools.

A second factor, which can be discussed perhaps only with the risk of making what may seem to be comparisons disparaging to the high schools, and this surely is not intended, is the value of the Short Course work to young men. Twelve or sixteen weeks at the college, away from home, is an experience that in itself is worth a great deal to any young man. He learns how to stand on his feet, decide certain moral questions for himself, and, in rubbing elbows with boys from all parts of the state, learns not only more about his own commonwealth but also, consciously or unconsciously, measures himself against individuals and new situations. These experiences are not so likely to occur in the home environment. One of the greatest satisfactions that comes to those responsible for short course work is from the awakening and development of many a lad whose future had previously seemed uncertain because of his lethargy and provincial point of view.

Beyond these moral benefits of the short course work lies the value of a course of study in which the student comes in contact with a number of instructors, each of whom is a specialist in some phase of agriculture, and for which there is available the well equipped laboratories, libraries and other college facilities. Even the graduate of the agricultural course in the high school can benefit in these ways by using the short courses for "post graduate" work.

From these different angles we believe that even with the development of the large number of Smith Hughes schools they have not yet begun to occupy the field to the exclusion of short course work.—F. G. HELYAR, *Director of Short Course, Rutgers, New Jersey.*

—Reprinted from *Quarterly of Alpha Zeta*, April, 1928.

VIRGIL, THE FARMER

Virgil, the greatest of the Roman poets, was born on October 15, 70 B. C., and died on September 12, 19 B. C. He received a learned education at Milan, Naples, and Rome. His father was a small farmer near Martus, in Cisalpine, or Gaul. After completing his education, Virgil returned to his father's farm.

In 42 B. C., after the battle of Philippi, in which Antony defeated Brutus and Cassius, Virgil's farm was taken from him, for he had been on the side of the patriot, Brutus, "the noblest Roman of them all." Afterwards it was restored to him, and as an instance of his gratitude he composed the first of his eclogues, in dialogue form, which begins thus:

Happy man! thy lands are yet thine own
Lands broad enough for thee, although bare stones
And marsh chop every field with reedy mud,
Strange pastures shall not rear thy teeming ewes,
Nor neighbors' flocks shed o'er them rank disease * * *

—*California Cultivator.*

GET IT DONE

It isn't the job we intended to do
 Or the labor we've just begun,
 That puts us right on the balance sheet,
 It's the work we have really done.

Our credit is built upon things we do,
 Our debit on things we shirk,
 The man who totals the biggest plus
 Is the man who completes his work.

Good intentions do not pay our bills,
 It is easy enough to plan,
 To wish is the play of an office boy,
 To do is the work of a man.

SAVING LIFE

The difference between barbarism and civilization is the different valuation placed on human life. Back in the middle ages, when a few people were rich and the great multitude of "common people" were in poverty, human life was about the cheapest thing in the world. The great buildings of the past were built at the sacrifice of thousands of lives by people who carried burdens on their backs and worked under the lash of a taskmaster * * *

Electricity is just coming into its own on the farm. It will mean another big economy. Call it luxury to sit down and watch a power washing machine do the rubbing for you; I call it economy. It saves life. It creates more years of opportunity, leaves more strength for the things you want to do, gives the mind time to develop.

Take the milking machine as an example. Anybody who has milked cows seven days in the week will agree with me that it comes very near to slavery at times. The milking machine makes it possible to do the job just as well, at less cost, and leaves a man a lot more free to attend to other things and think about his farm management.

Think of these new things not as an expense, but as real hard-fisted economy. Why waste a man's time doing work that a machine will do for the ridiculous wage of two or three cents per hour? Why break your back, or wear out your wife's life carrying endless buckets of water when you can harness the pump with a quiet running system that delivers all the water you want? And, confidentially, why struggle around trying to get a bath in the washtub with a teakettle of water, when for comparatively little cost you can have the luxury of a big white tub brimming with crystal clear water, hot, warm, or cool, as you wish?

—*The Prairie Farmer* (Illinois).

THE JAPANESE IMPERIAL GOVERNMENT INSTITUTE FOR NUTRITION¹

F. O. SANTOS

Of the Department of Agricultural Chemistry

Last April at the request of Dr. José Fabella, Public Welfare Commissioner for the Philippine Islands, and with the permission of the University of the Philippines, I went to Japan to study the nutrition work of the Japanese with special reference to the working of the Imperial Government Institute for Nutrition. At the Institute I was welcomed by the Director, Dr. Tadasu Saiki, who promised to give me all assistance in the work which I was planning to do and in the following words assured me of his earnest co-operation: "Our work is international and as such it is essential that we co-operate with each other." From the first meeting with the Director, I was impressed with his personality and with the enthusiasm which he showed in his work.

After an hour in the Institute, newspaper men arrived to interview me. The considerable attention the papers gave the purpose of my visit is a strong indication that the Japanese people as a whole are aware of the importance of the study of nutrition to the welfare of the people. A brief account of the work I was planning to do was published in several of the leading papers in Tokyo. The interest of the Japanese in my work was much greater than the interest of the Filipinos here at home. Within the first few days I was in Japan, many men came to me and said that they were glad to know that I had come to Japan for such a commendable purpose.

The longer I stayed in Tokyo the more I felt the strong personality of Doctor Saiki, the Director of the Institute. He has taken the study of nutrition as his life work and he is in it heart and soul. Besides performing the duties of Director of the Institute, he is also busy in other nutritional activities. The importance of the work Doctor Saiki is doing may be gauged by the fact that, financed by the League of Nations, he has just returned from a lecture trip in Europe and the two Americas. At present, he is maturing a plan for the holding of a Far Eastern Congress of Nutrition.

ORIGIN OF THE INSTITUTE

The Imperial Government Institute for Nutrition is an outgrowth of a private nutrition laboratory established by Dr. Tadasu Saiki in 1915. This laboratory investigated the nutritional problems of Japan "as an independ-

¹ Read at the meeting of the Los Baños Biological Club, July 26, 1928. Received for publication August 9, 1928. General contribution from College of Agriculture No. 209.

ent special branch of science which hitherto has been considered a mere insignificant branch of the medical or agricultural sciences." In this laboratory were studied the methods of improvement in the uses of main foods, the values of substitute food, the influence of unbalanced diet and also of the vitamins. It had a clinical division for diet therapy; and a bakery, where improvements in bread making were studied. Classes were held for physicians and school teachers. Popular lectures and demonstrations were given to the general public. The work of this private laboratory attracted the attention of the Department of Education which gave it certain sums of money for the encouragement of research. Then, the government realizing the importance of the work that was being done, in 1920 promulgated an ordinance establishing the Imperial Government Institute for Nutrition with Dr. Tadasu Saiki as director.

When the Institute was opened the senior scientist and the government authorities encouraged the members of the institute with the following words: "Research work requires time, do not hasten for achievement."

BUILDINGS

The corner stone of the principal building was laid in November, 1920, and it was completed by October, 1921. The whole plant cost about ₱350,000. The following rooms and laboratories are provided for, each laboratory in a room by itself.

1. Room for guests.
2. Reading room.
3. The Library.
4. Toilet.
5. Vitamin Laboratory.
6. Laboratory for Economical Nutrition.
7. Animal Room.
8. Balance Room.
9. Incubator, Centrifugal and Shaking Machine Room.
10. Nitrogen Determination Room.
11. Digestion and Draft Room.
12. Hydrogen Sulphide Room.
13. Stock Room.
14. Ether Room.
15. Elemental Analysis and Ammonia Room.
16. Laboratory for Metabolic Experiments and Food Chemistry.
17. Machinery Room.
18. Polishing Room.
19. Stockroom.
20. Garage.
21. Toilet.
22. Room for Cookery.
23. Bathroom.
24. Employees Room for Women.
25. Kitchen.
26. Dining Room.

27. Employees Room.
28. Room for Night Watch Officer.
29. Room for Subjects under Observation.
30. Toilet Room for Subjects under Observation.
31. Attached Room for Physiological Laboratory.
32. Calorimetric Room.
33. Physiological Laboratory.
34. Director's Room.
35. Director's Laboratory.
36. Bacteriological Laboratory.
37. Microscopic Room.
38. Laboratory for Food Industry.
39. Boiler Room.
40. Laboratory for Food Industry.
41. Thermostat Room.
42. Koji Room (yeast cake).
43. Fermentation Room.
44. Stockroom.
45. Office.
46. Reception Room.
48. Optical Room.
49. Lecture Hall.
50. Garden for Famine Relief Food Materials.
51. Tank for Experimental Fish.
52. Poultry Yard.

PERSONNEL

The personnel of the Institute is as follows:

Director	1
Experts	7
Assistant experts	15
Secretaries	2
Volunteer investigators	

The experts may be classified as follows:

- 6 medical college graduates
- 5 pharmacological college graduates
- 6 agricultural college graduates
- 4 chemical engineers
- 1 scientific school graduate

Dr. Tadasu Saiki, the Director, is a very energetic man. He is a holder of the Ph.D. degree from Yale University, 1905, and the *Igakuhakushi*, one of the highest academic degree given by the Japanese Government.

Three of the experts have had foreign training in Europe and America.

The volunteer investigators are men who work for no pay but are given all facilities and are allowed to publish their work under their own names. These men are, therefore, able to use the results of their investigations for obtaining advanced degrees and are thus enabled to prepare for higher and better paid positions.

SALARIES

The investigators receive salaries which are relatively lower than those received by the professors in the College of Agriculture. In this connection it must be borne in mind that though the salaries of the Japanese are lower than ours, I am of the impression, although I have no figures on the subject, that living in Japan is a little cheaper than in the Philippines. It, also, is true, that the employees in the Institute are able to accept low salaries for, sooner or later, because of the training that they get there, they, later, secure much better paying jobs as the demand for well-trained scientists in Japan is very great. Japan has four imperial universities, several private universities and many technical schools and also scientific laboratories which are always in need of men well trained in scientific work. This state of affairs does not obtain in the Islands, hence the necessity for a man in our country demanding better pay as the chances for him to get work outside the university are practically nonexistent. The policy of the director of the institute in allowing the members of his staff to publish work under their own names encourages ambitious and energetic young men to accept lower pay. Because of their meritorious publications three members of the institute already have been honored by the government with the *Igakuhakushi* degree. With this degree, of course, went honors and increase in pay.

EQUIPMENT

The laboratories of the Institute are better equipped than ours of the University of the Philippines. In this connection, one can not help but notice the scarcity of foreign made apparatus in the Institute. Most of it is made in Japan—even the greater part of the chemicals used are manufactured in the country. However, when it comes to office equipment, even the poorly equipped College of Agriculture surpasses this famous Japanese Institute. Revolving chairs are unknown. The tables of the chiefs of the divisions are far inferior to the tables the College of Agriculture gives to the graduate assistants. *All is simplicity and money is not spent on things not essential to the real work of the Institute.*

The Institute has several clocks which attracted my attention for they were not keeping the right time; and I found that no effort was made to make them do so. On examination I discovered that the clocks are used only for experimental purposes and not for informing the workers when to stop and go home. It is not uncommon to see a man stay late in the evening for work that can not be stopped at the official closing time.

WORK OF THE INSTITUTE

The work of the Institute is divided into the following departments and divisions:

- I. Department for Investigation of the Fundamental Science of Nutrition.
 1. Division of Food Chemistry.
 2. “ “ Metabolism.

3. Division of Physiology and Pathology.
4. " " Micrology.
5. " " Physics.
- II. Department for Investigation of the Applied Science of Nutrition.
 1. Division of Investigation of Food Materials.
 - a. Natural food products (including aquatic products and famine relief food materials).
 - b. Food Industry.
 - c. Investigation of Animal and Plant kingdoms for new foods.
 2. Division of Economical Nutrition.
 3. " " Preservation and Distribution.
 4. " " Cookery and Tableware.
 5. " " Infantile Nutrition.
 6. " " Department of Waste Products.
- III. Department of Inquiry.
 1. Division of Inquiry, Statistics, Historical Materials.
 2. Class in Nutrition, Exhibition, and Propaganda.
- IV. Department of General Affairs.
 1. Division of personal affairs, correspondence, etc.
 2. Division of supplies and accounts.

Published work

The work of the Institute has been published in two volumes; unfortunately for us, it is written in Japanese. A third volume is under preparation. The titles of the most important publications are:

1. Studies on Japanese metabolism: I.
2. Studies on Japanese metabolism: II.
3. Determination of body area and its formula expressed.
4. Basal metabolism of free labor.
5. Excretion of urea-N and acidosis during fasting.
6. Mineral excretion during fasting.
7. General observation on fasting.
8. Fasting at Mount Narita.
9. Relationship between different grades of polishing and digestibility and utilization of rice.
10. Relationship between cookery and digestibility and utilization of rice.
11. Influence of bathing on metabolism.
12. Excretion of vitamin in urine—whether normal urine contains vitamin B or not.

Some of the publications are important enough to have attracted the attention of the League of Nations and the League has published the following in English:

1. The basal metabolism of normal Japanese men and women.
2. The basal metabolism of common laborers.
3. The measurement of the body surface area of man.
4. Metabolism during fasting and subsequent re-feeding.
5. Improvement of the physical condition of malnourished children.
6. Studies on the digestibility and utilization of rice of different grades of polishing.
7. The digestibility and utilization of rice cooked by different methods.
8. The biological value of the nitrogenous substances found in our main vegetable foods.

9. Biochemical studies on rice. Differences in the physico-chemical properties of the protein oryzenin as it occurs in glutinous and in common rice.
10. Biochemical studies of rice. Part I. Oxidase.
11. The relationship between the chemical composition of rice and the different grades of polishing.
12. Chemical properties and nutritive value of the protein of Italian millet (*Setaria italica* Kth.).
13. Studies on the proteins of buckwheat (*Gagopyrum esculentum* Moench) and its nutritive value.
14. Vitamin content of Japanese food materials.
15. Relationship between the quantity of salts in a diet and the deficiency in vitamin A.
16. Formation of urinary and bile-duct calculi in animals fed on experiment rations.
17. Formation of gastric garcinoma in albino rats fed on deficient diets.

Besides these reports, the results obtained by the Institute are published in popular form in the daily papers. The radio which has invaded even the homes of the poor people in Japan is found to be a very good medium for the broadcasting of the work of the Institute. In Tokyo, every morning the radio broadcasts the names and the market prices of the foods obtainable.

Present investigations

At present, the following investigations are in progress:

1. On the curing of fracture by diets.
2. Formation and treatment of urinary gall-bladder and stones by means of diet.
3. Formation of cancer by diet.
4. Nutrition and wounds.
5. Investigation of vitamin content of Japanese food materials.
6. Nearsightedness and nutrition.
7. Quantitative analysis of bones.
8. Investigations on Japanese daily menu.
9. Relationship between life and nutrition.
10. Influence of mental work on digestibility and utilization of food.
11. On the sprouting of beans.
12. Studies on enzymes with reference to vegetable enzymes.
13. Studies on intestinal flora.
14. Reproduction and nutrition.
15. Mineral constituents of Japanese foods.
16. Nutritive value of famine relief foods.
17. Studies on vitamin D—anti-vitamin D or anti-calcifying vitamin in Japanese rice.
18. Pro-vitamin D—nature of in butter-fat.
19. Effect of sun-drying on vitamin D production in some Japanese dry food.
20. Utilization of rice-polishings (industrial) for fish (eels, carps, etc.).
21. Photosynthesis of food, especially carbohydrates and proteins.
22. Relations between nutrition and parasites, especially in fish.
23. Routine work on proximate analysis of Japanese foods.
24. Chemical methods of identification of old and new food materials—cereals, beans, etc.
25. Basal metabolism of Japanese school children (boys and girls).
26. Metabolism during muscular exercise and fatigue.

27. Relation of diet and fatigue, etc.
28. Metabolism during mental exercise.
29. On vegetarian diet.
30. Studies on hunger, fasting, and under-nourishment.
31. On the digestibility of foods, as rice, barley, wheat, buckwheat, etc.
32. On intestinal bacteria.
33. Effect of food on intestinal bacteria.

THE JAPAN NUTRITION ASSOCIATION

Working in co-operation with the Imperial Government Institute for Nutrition, but not a part of it, is the Japan Nutrition Association. This association was organized through the efforts of Doctor Saiki. At present, it is giving school lunches to more than 10,000 public school children. In Japanese elementary schools the classes continue from morning till afternoon and the pupils do not go home for lunch. The beneficial effect of these association lunches is so gratifying that the plan is being introduced in the private schools. The income of this association comes from government subsidy, from donations, and from contributions of members.

Progressive Japan finds it necessary to support an institute for nutrition. In the Philippines the need for studying the nutrition of the people is greater than in Japan. The welfare of the Filipino people demands that the Government pay attention to this important question.

GRAY SPOT, OR BLIGHT OF COCONUT¹

FELIPE CORTEZ

WITH THREE PLATES

THE DISEASE

The gray spot, or blight of coconut (*Cocos nucifera* L.) is the most common leaf disease of this palm in the Philippine Islands. The malady seems to occur in all countries where coconut is grown.

According to Copeland (1921) *Pestalozzia palmarum* Cke. was first described from British Guiana. It has been reported that the disease has done a considerable damage in Mindanao, Malay States, New Hebrides, Saleier Islands, and Bismarck Archipelago. The disease became an epidemic at Kempit, Java, where the outbreak was studied and reported by Bernard.

Driberg (1889) reported a parasitic fungus on the gray spot of coconut in Ceylon and Busck (1902) described the disease in Cuba. Stockdale (1906) reported the disease in Trinidad. The gray spot of coconut was first mentioned in Philippine literature by Barrett (1912) and subsequently by Baker (1914).

Munro and Brown (1920) reported an outbreak of the leaf disease in some of the young nurseries in Sumatra although there was but a little damage done.

The gray spot does not kill the coconut but, by killing portions of the pinnae, it undoubtedly reduces the capacity of the plant to synthesize its organic foods. Beyond the supposition that the disease affects the functional capacity of leaves of the coconut, nothing is known about the actual amount of injury that it produces. It is believed that gray spot does much injury because in severe cases all the leaves except the youngest ones appear gray owing to the abundance of the spots. But, it is not definitely known whether the *Pestalozzia* which is associated with the gray spot is the cause of the malady or a saprophyte on weakened tissues of the leaves and lesions that have been produced by other more aggressive parasites. With the exception of the work of Bertus (1927) in Ceylon, very little work has been done to establish the relation of *Pestalozzia palmarum* to the leaves of the coconut.

Symptoms and signs

In early stages of infection the disease is characterized by small, yellowish brown, circular to oblong, and more or less depressed spots which are

¹ Thesis presented for graduation, 1928, with the degree of Bachelor of Agriculture, from the College of Agriculture, University of the Philippines, No. 268; Experiment Station contribution No. 547. Prepared in the Department of Plant Pathology under the direction of Dr. G. O. Ocfemia.

about a millimeter in diameter (plate I, b.) The diseased areas gradually increase uniformly in length and width. The yellowish brown spots are seen surrounded by a grayish brown band which is about a millimeter in width. Sometimes this band does not extend completely around the spots. Within this brown band there is a cream-colored portion which appears much thinner than the healthy parts of the leaf. In some cases the thinner central portions of the spots appear dark brown. The lesions tend to grow in length parallel to the veins. On rainy days the spots appear grayish.

In advanced stages of the disease the spots may be as large as five centimeters long and one or more centimeters wide. The central portion of the spot becomes gray. The brown band at the border becomes dark brown. Two to five or more spots may coalesce forming larger, irregular, gray, dead areas. On the upper surface of the pinnae, black minute, dot-like bodies consisting of the fruiting structures of the fungus soon appear on the grayish center (plate I, d and plate II, fig. 1a and b and fig. 2c and d) The dead areas are then surrounded by dark brown bands. These bands are in turn surrounded by three zones. The first zone is yellowish green; the second, brown; and the third, or outermost, yellowish green. The third zone is of practically the same width as the first zone (plate I, d), which is about three millimeters. The middle zone is 1.5 millimeters wide. In some cases the pinna becomes yellow and then dies. Both young and old spots spread rapidly on rainy days. If the air is very dry, the lesions develop slowly, and the spots do not appear until the leaves are old. The lesions on the leaves which dry and fall off become gray, except the band at their borders which appears dark brown. The lesion becomes studded with the black minute fruiting bodies which generally appear on the gray central portion on the upper surface of the leaves, but sometimes on the lower surface. The lesions do not seem to increase in number but the mycelium spreads all over the upper surface of the leaves. During moist weather this mycelium becomes the source of the fruiting bodies which may spread all over the upper surface of the leaves (plate II, fig. 2a, b, c, d) and sometimes on the lower surface, too.

CAUSAL ORGANISM

Morphology

Pestalozzia is always associated with all gray spot lesions on coconut leaves. In advanced stages of infection the conidia of this fungus are present in the black specks of fruiting bodies. In early stages of the disease, the mycelium which is present on the lesions, when isolated, always proves to be that of a *Pestalozzia*.

Mycelium. In pure culture, both submerged and aerial hyphae are produced. When young, the submerged mycelium is densely granular, septate, hyaline, vacuolate and somewhat irregular in outline. The cross walls are somewhat hard to distinguish. When old, the granules of the

mycelium disappear. The aërial mycelium, when young, is very sparsely granular, and hyaline. When old, granules seem to be absent from the cells of the mycelium.

The hyphae are thin-walled and branched (plate III, fig. 2, 3, and 5). The branches arise either from the middle of the cell or near the cross walls. The branches are usually smaller than the main hyphae. Fusion of hyphae (plate III, fig. 3) similar to that of other higher fungi was noted on oatmeal agar culture.

The width of the hyphae varies from 1.8 to 6.48 μ on soybean agar and corn meal agar, and 1.8 to 6.84 μ on oatmeal agar. Bertus (1927) found that the diameter of the hyphae of *Pestalozzia palmarum* may be 3 μ on oatmeal agar and French bean agar, though usually between 2 to 3 μ in diameter on corn meal agar. As these figures show, the width of the mycelium of the Philippine *Pestalozzia* resembles that of *Pestalozzia palmarum* in Ceylon. Bertus (1927) states that the width of the swellings of some profusely branched and irregularly swollen hyphae reaches nearly 7 μ on oatmeal agar and about 5 μ on corn meal agar.

Fruiting bodies. In pure culture and on the leaves of coconut the fruiting bodies appear as black dots. On the leaves they are sub-epidermal (plate III, fig. 4), but at maturity they appear to be located on the epidermis because the epidermal layer is ruptured. In wet weather the mycelium spreads all over the upper and sometimes over the lower surface also and forms fruiting bodies outside of the lesions (plate II, fig. 2a, b, c, d). In pure culture they are formed on the surface of the media. The fungus produces acervuli though Bertus (1927) considers the fruiting bodies of *P. Palmarum* and *P. theae* Sawada as pycnidia. Cooke (1906) states that "*P. guépini* Desm. has no perithecia, the sporules (conidia) being produced in small cavities in the substance of the leaf the surrounding cells modified and discoloured so as to form a false receptacle." Duggar (1909) calls the fruiting bodies of *P. guépini* Desm. var. *vacinii* Shear acervuli.

Immature sporocarps are of various shapes (plate III, fig. 4). According to Bertus (1927) the fruiting bodies of *Pestalozzia palmarum* may be globose, spherical, rectangular or oval. The writer noted that the fruiting bodies from the leaves vary from 550.0 to 858.0 μ in diameter, but Bertus' (1927) measurements of the sporocarps of *Pestalozzia palmarum* from the leaves in Ceylon are much smaller, being only 130 to 420 μ in diameter. In pure culture, on soybean agar, the acervuli of the Philippine *Pestalozzia* may be up to 624.0 μ in diameter. Bertus (1927) reports that the greatest width of the fruiting bodies of *Pestalozzia palmarum* on oatmeal agar is 240 μ . The figures show that the fruiting bodies of the Philippine *Pestalozzia* are larger than those of Bertus' *P. palmarum*. The writer believes that the difference cannot be considered of taxonomic importance because it may be attributed to a possible difference of environmental and other conditions in the Philippines and in Ceylon.

Conidia. The conidia of the coconut *Pestalozzia* are borne on short hyaline pedicels (plate III, fig. 1 and 8). In pure culture they are 0.7 to 20.0 μ long, but on the leaves they are 0.7 to 3.3 μ . Bertus (1927) reports that the pedicels of the Ceylon *Pestalozzia palmarum* are 1 to 5 μ on oatmeal agar, 1 to 3 μ on French bean agar and corn meal agar, and 2 to 5 μ on the leaves.

In pure culture, the spores of the Philippine coconut *Pestalozzia* seem to arise from a pseudo-parenchymatous layer of the acervuli (plate III, fig. 4). They are yellowish to light green when young and turn brown with age. At maturity the conidia are free from the pedicels. They are spindle-shaped, somewhat curved, tapering at both ends with hyaline terminal cells, one of which, the distal end, bears appendages, and bulges in the region of the colored cells (plate III, fig. 1). The conidia are 11.7–28.3 $\times$ 3.3–6.7 μ in pure culture on oatmeal agar, soybean agar, and corn meal agar and 14.4–21.6 $\times$ 4.7–7.2 μ on the leaves. Bertus (1927) reports that the conidia are 15–25 $\times$ 5.0–7.0 μ in pure culture on oatmeal agar, French bean agar, and corn meal agar and 15–25 $\times$ 5–7 μ on the leaves.

On the leaves, the spores usually have from one to three hyaline appendages, though on the leaves and in pure culture on soybean agar they may have from one to four (plate III, fig. 1).

The conidia of the Philippine fungus and those of Ceylon average almost the same in size. The average size of the conidia of the Philippine fungus in pure culture is 19 $\times$ 4.7 μ , and on the leaves, 18.3 $\times$ 6.1 μ ; those of the Ceylon fungus in pure culture are 18.7 $\times$ 5.5 μ and on the leaves, 20.2 $\times$ 5.7 μ .

The appendages of the spores from pure culture vary in length from 4 to 28.3 μ , and on the leaves from 7.2 to 25.2 μ . On the leaves the appendages are slightly bulging at the apical end. Bertus (1927) states that the appendages of the spores of *Pestalozzia palmarum* are generally about 5 μ in length, rarely 10 to 12 μ . He further states that on leaves the appendages are generally about 20 μ long, but a few spores have appendages as long as 40 μ .

The spores usually contain three brown cells, though some of them may have from one to five (plate III, fig. 1). In general, the appendages of the Philippine *Pestalozzia* in pure culture are 16.3 μ longer than the Ceylon species, but on the leaves those of the Ceylon *Pestalozzia* are 14.8 μ longer. The number of colored cells may vary on the leaves and on different culture media. On soybean agar, two to five colored cells may be present, and in rare cases a spore with six brown cells may be noted. On oatmeal agar the colored cells vary from one to four and on corn meal agar and on the leaves from two to three.

The conidia of the Philippine fungus in pure culture have from one to five colored cells and one to four appendages, while those of the Ceylon fungus have from three to five colored cells and two to three appendages.

On the leaves the conidia of the Philippine fungus have from one to three colored cells and one to four appendages, while those of the Ceylon fungus have from three to five colored cells and from three to four appendages. The conidia of both fungi have appendages with bulging apical ends. These slight differences seem to be due to environmental conditions.

Physiology

Germination of spores. Some of the spores from an acervulus of an 18-day-old culture on oatmeal agar were suspended in hanging drops of sterile rain water, and others in nutrient solution in Van Tieghem cells. The spores germinated in about four hours and twenty-three minutes in sterile rain water but they did not germinate in hanging drops of nutrient solution. The spores germinate by sending out a germ tube usually from the last brown cell toward the proximal hyaline end, though the germ tubes may appear from any of the colored cells also.

Behavior on artificial media and substrata. The fungus was grown in five culture tubes each of oatmeal agar, corn meal agar, soybean agar, potato-dextrose agar, water agar, corn meal, sterilized corn cylinder, camote stem, abacá corm, sugar cane stem, pepper stem, banana corm, eggplant fruit, and tomato stem. Twenty hours after the transfers were made, white, rather coarse, mycelial growth was observed on all media except on water agar on which the fungus did not produce growth. An abundance of growth was noted on oatmeal agar, soybean agar, and sterilized corn meal, and fairly abundant growth was made on corn meal agar and camote stem. On potato-dextrose agar, sugar cane stem, pepper stem, banana corm, and eggplant fruit the growth of the fungus was scanty. On tomato stem, abacá corm, and corn cylinders the growth was very poor. Yellow, glistening, butyrous, and spreading substance was noted on the seventh day at the center of the growth on potato-dextrose agar. As the cultures grew old this substance spread to the base and edge of the slants. Generally, the growth of the mycelium on all media was first slow and creeping, then it became faster, until the mycelium was thick. The growth of the hyphae was both aërial and submerged. On all substrata the growth of the fungus was generally aërial. Zonation was clear on all media, especially on oatmeal agar, soybean agar, corn meal agar, potato-dextrose agar, camote stem, and pepper stem. Two to three zones were noted on the growth of mycelium in four to six days. As the fungus grew old the growth in the first zone was usually covered with fruiting bodies. The mycelium then lost its fluffy appearance. Owing to the formation of numerous fruiting bodies the surface of the medium and substratum became covered with black, shiny, tar-like slimy masses of sporocarps. In some instances the growth on corn meal agar, soybean agar, and oatmeal agar extended farther than the base of the slants.

All the media were colored when they became old. The color¹ of the oatmeal agar was from cinnamon buff to light ochraceous salmon; corn meal agar, from sayal brown to ochraceous tawny; soybean agar, from isabella to buckthorn brown; and potato-dextrose agar, from hazel to cinnamon brown. All substrata became dark colored with age.

The fruiting bodies are at first silver gray, somewhat resinous specks, but later they turn tar black. The spores were produced five days after transfer on corn meal agar, potato-dextrose agar, sugar cane stem and corn meal. On oatmeal agar, soybean agar, abacá corm and eggplant fruit the spores began to form in four days. On camote stem, pepper stem, and banana corm the spores were produced three days after transfer. On corn cylinders the spores were formed in seven days and on tomato stem in fourteen. Spores were abundant on oatmeal agar, soybean agar, corn meal agar, camote stem, and pepper stem. They were fairly abundant on abacá corm, sugar cane stem, banana corm, and eggplant fruit. On potato-dextrose agar, corn meal, corn cylinder and tomato stem the spores were very few.

Growth in plate culture. Petri dishes containing corn meal agar, soybean agar, potato-dextrose agar and oatmeal agar were also used in the study of the growth of the Philippine *Pestalozzia* of the coconut. An opaque, white, rather coarse, mycelial growth was observed, as with the tube cultures on all media, 20 hours after the transfers were made. An abundant growth was produced on oatmeal agar and soybean agar plate cultures, and fairly abundant growth on corn meal agar plate cultures. The growth in four days was about three centimeters in diameter. Zonation was very distinct on corn meal agar and potato-dextrose agar. Two to three zones were observed at the end of six days. On potato-dextrose agar and corn meal agar plate cultures, the mycelium was somewhat scanty.

Growth in diffuse light and in darkness. Slant cultures on corn meal agar, soybean agar, oatmeal agar and potato-dextrose agar were placed in darkness inside a case and others were left in the laboratory close to the window to determine the effect of these upon the growth of the Philippine *Pestalozzia* of the coconut. Four days after the transfers were made the growth in the tubes on oatmeal agar in the laboratory was profuse, fluffy, white, cottony and rather confined above the surface of the agar. A few spores were noted in the tubes in the laboratory, but none in darkness. Five days after the transfer was made fruiting bodies were produced in the tubes of corn meal agar in the laboratory, while in darkness no fruiting bodies were produced. Seven days after transfer, fruiting bodies were present in the tubes of corn meal agar, oatmeal agar, and soybean agar in the laboratory, while in darkness only the tubes of soybean agar had fruiting bodies.

¹The color nomenclature in this paper is after: Ridgway, R. 1912. Color standards and color nomenclature iii+43 p., 53 pl. Baltimore, Md.: A. Hoen & Company.

Observation seems to show that darkness hinders the growth of the fungus and its production of spores.

Pathogenicity

Field inoculation. In order to determine whether or not the *Pestalozzia* associated with the gray spot, or blight of Philippine coconuts, is capable of infecting healthy coconut leaves, inoculations were made using coconut seedlings about two years old on the experimental plot of the Department of Plant Pathology. Healthy seedlings were selected and the oldest leaves of these were removed. The pinnae of selected leaves were rubbed gently for five minutes with absorbent cotton immersed in 1:1000 mercuric chloride solution and then the disinfectant was washed off thoroughly with sterile rain water. Inoculations were made as follows:

- (1) By spraying the leaves on the upper and lower surfaces with a suspension of spores from pure culture on potato-dextrose agar, oatmeal agar, soybean agar, and corn meal agar.
- (2) By putting bits of agar containing the black fruiting bodies on the upper and lower surfaces using a sterile platinum needle.
- (3) By placing bits of agar with the fungus on it on needle pricks made through the upper and lower surfaces of the leaves.
- (4) By spraying with a suspension of spores on needle pricks made through the upper and lower surfaces of the leaves.

Each method of inoculation was checked with control pinnae which were treated in exactly the same manner except that no fungus was used. Some of the inoculated seedlings were bagged with paraffin paper and others were placed in large glass tubes which were plugged loosely with absorbent cotton at both ends.

On the third day, infection was observed on all pinnae inoculated through wounds, but no evidence of infection was noted on pinnae inoculated without wounds. Young infections were characterized by yellowish brown spots which were about a millimeter in diameter (plate I, b). The spots were circular to oblong and somewhat shrunken. The lesions gradually increased uniformly in length and width. The production of spots was accelerated by rain. The writer observed that in inoculations during dry weather the incubation period was not shorter than five days. In advanced stages of infection the patches became gray, as in natural infection (plate I, d). The spots turned dark brown. The lesions soon coalesced forming larger irregular dead areas (plate I, d). The black fruiting bodies appeared on the gray centers of the lesions on the upper surface of the pinnae in seven to eleven days. The control seedlings remained healthy throughout the experiments.

Inoculation of coconut pinnae by methods 3 and 4 was repeated 20 times, and inoculation by methods 1 and 2 was repeated 100 times, with the same results.

Damp chamber inoculation of coconut pinnae

Following Bertus' (1927) method of inoculation coconut pinnae were cut into pieces about fifteen centimeters long. They were sterilized for five minutes with 1:1000 mercuric chloride solution and then washed thoroughly in sterile rain water. Some of the pinnae were inoculated, following methods used in the field infection experiment on coconut seedlings. Other pinnae were inoculated by putting bits of agar containing fruiting bodies from pure culture on oatmeal agar on the upper and lower surfaces and by coating them with a thin layer of paraffin. Each method was checked with control pinnae which were treated in exactly the same manner except that no fungus was used. The inoculated and check pinnae were placed in separate glass damp chambers.

The pinnae inoculated without wounds and those coated with thin paraffin failed to take infection. All the pinnae inoculated through wounds gave 100 per cent of infection on the third day. One week after inoculation fruiting bodies appeared on the spots on the lower surface of the pinnae. The spots were identical with those obtained from field inoculation experiments. A slight difference in the formation of fruiting bodies, however, was noted. On the spots produced in the field the fruiting bodies appeared on the gray central portion of the spots on the upper surface of the pinnae. On lesions in damp chamber inoculations the fruiting bodies appeared on the lower surface of the pinnae. When field infected pinnae were placed in damp chambers the fruiting bodies developed either on the upper or lower surface. When the fruiting bodies were already developed on the upper surface of the pinnae in the field, when placed in the chamber some acervuli would also arise from the lower surface of the same pinnae. The control pinnae used in these experiments remained healthy throughout the work.

The abundance and uniform distribution of leaf spots in nature seem to be due to the fact that pinnae which dry and fall off because of numerous lesions become uniformly covered with the black fruiting bodies all over the upper surface and on part on the lower surface (plate II, fig. 2a, b, c, and d). It seems as if these fruiting bodies, if they are produced on the green areas of the pinnae, finally establish a food relation with the host. Although no work was done to check up on this point the writer believes that the spread of the fruiting bodies on the entire upper or lower surface of the leaves explains the distribution of the spots on the pinnae in nature.

Relation of moisture to infection. In all inoculations to determine the relation of the fungus to the coconut the writer noted that the lesions were produced earlier and they increased in size faster when it rained almost daily than during dry weather. When it did not rain for some time it took as long as five days for the spots to develop. Although no attempt was made to study the relative humidity of the surrounding atmosphere

which is most favorable for infection the writer believes that this observation shows that moisture favors the production of disease.

Re-isolations. In all inoculation experiments the fungus used was always obtained in re-isolation. From the incipient lesions re-isolations of the causal fungus were made and in all cases a *Pestalozzia* identical with the organism used was recovered.

Relation to other plants. The writer found that the *Pestalozzia* of the coconut leaves is able to infect, through wounds, cabo-negro (*Arenga saccharifera* Wurm), pugahan (*Caryota cumingii* Blume), buña (*Areca catechu* L.), royal palm (*Oreodoxa regia* HBK.), and *Phykosperma macarthurii*.

Taxonomy

The spores of the Philippine coconut *Pestalozzia* have one to five brown cells. Bertus (1927) mentions three as the typical number in the Ceylon fungus although he found two abnormal spores on leaves, and one abnormal spore on French bean agar containing five brown cells. The writer noted that spores containing four colored cells were common on oatmeal agar culture and five on soybean agar culture. The appendages of the Philippine coconut *Pestalozzia* are bulging at the apical end in nature as in the Ceylon fungus (Bertus, 1927). Measurements of the Philippine coconut *Pestalozzia* are nearly the same as those of the Ceylon organism. The average size of the spores of the Philippine and Ceylon coconut *Pestalozzia* are shown in table 1.

TABLE 1

Average size of the spores of the Philippine coconut *Pestalozzia* as compared with those of the Ceylon *Pestalozzia palmarum*

OBSERVER	SOURCE OF SPORES	LENGTH, INCLUDING TERMINAL HYALINE CELLS	LENGTH OF COLORED CELLS	WIDTH
		microns	microns	
The writer.....	Coconut <i>Pestalozzia</i> in nature.....	18.3	11.2	6.1
Bertus.....	Coconut <i>Pestalozzia</i> in nature.....	20.2	13.8	5.7
The writer.....	Coconut <i>Pestalozzia</i> in culture.....	19.0	12.0	4.7
Bertus.....	Coconut <i>Pestalozzia</i> in culture.....	18.5	12.0	5.5

Bertus (1927) states that the appendages of the spores of the Ceylon coconut *Pestalozzia* are comparatively short, being on the average about 12μ long. The writer found that the appendages of the Philippine coconut *Pestalozzia* are comparatively long.

There is a close agreement in the average size of the spores of the Philippine and Ceylon coconut *Pestalozzia*. The average size of the spores in pure culture is nearly the same as that of the Ceylon species of Bertus (1927), except in the length including the terminal hyaline cells, those in the Philippine fungus are 0.4μ shorter. The average width of the spores

of the Ceylon fungus in nature is only 0.3μ narrower than that of the Philippine organism. In nature the average length of the spores of the Philippine *Pestalozzia* including the terminal hyaline cells is 1.9μ shorter than the Ceylon. The average length of the colored cells of the Philippine fungus in nature is 2.6μ shorter than the Ceylon fungus.

In pure culture the Philippine and Ceylon fungi do not produce appendages which bulge at the apical end. They both produce appendages of this kind in nature. They can not infect leaves of coconut unless these are wounded.

The discrepancies in size of *Pestalozzia palmarum* Cke. and the writer's coconut *Pestalozzia* are very small and they cannot be considered of taxonomic importance. In morphological and host relationships the writer's coconut *Pestalozzia* cannot very well be separated from the widespread *P. palmarum* Cke. The writer concludes that the Philippine species is identical with *Pestalozzia palmarum* Cke. of Bertus (1927) of Ceylon.

LIFE HISTORY OF PESTALOZZIA PALMARUM CKE. IN RELATION TO PATHOGENESIS

Source of inoculum for natural infection

Pestalozzia palmarum Cke. is normally a facultative parasite. The mycelium thrives on old and dead coconut leaves in the field. When conditions are favorable for its development the mycelium produces fruiting bodies the spores of which are inocula for primary infection in the field.

Method of dissemination and transmission

Pestalozzia palmarum is abundant in every coconut plantation near the College of Agriculture and in Laguna and Tayabas provinces and probably elsewhere in the Philippines. The fungus may be carried unintentionally by men from one place to another with green or dead leaves. No work was done to determine the exact method of transmission. On account of the fact that at maturity the fruiting bodies are open and the conidia are readily detached the writer believes that rain and wind are the most important agencies of dissemination.

Method of penetration

The fungus penetrates the host tissue only through wounds. Stockdale (1906) states that "infection experiments leave no doubt that this leaf fungus (*P. palmarum* Cke.) may be weakly parasitic, and show that infection can take place by the germination of the spores, the germinal tubes of which can pass through the stomata of the leaf and through wounds of any kind on the leaf surfaces. No result, however, was obtained when the spores were placed on the upper surface of an uninjured leaf, which may indicate that these germinal tubes are incapable of penetrating through the epidermis of the leaf." In the writer's work the fungus infected the leaves only through wounds. The uniform distribution of leaf spots in nature seems

to be occasioned by the mycelium which radiate in all directions outside the original lesion. This mycelium on invading the healthy green areas produces other lesions.

Relation of the mycelium to the host cells

Examination of free hand cross sections of the lesions showed that the hyphae are intercellular. After the hyphae gain entrance into the tissues of the leaf, they branch out in all directions. A lesion when examined under the microscope shows the mycelium forming web-like structures. The tissues of the lesion die in about 70 days. At this time the fruiting bodies are conspicuous.

Method of aestivation

The fungus lives, from one season to another, as mycelium within the tissues of the coconut leaves. The leaves which dry and fall off owing to the disease serve as the resting place of the fungus.

CONTROL MEASURES

Under field conditions the Philippine *Pestalozzia palmarum* may cause serious injury to coconut leaves especially if environmental conditions are favorable, or in places not wholly suitable for coconut culture. The writer did not study special control measures. The following measures which may be of value in seed beds and in young groves in the Philippine Islands are recommended by various authors.

According to Copeland (1921), Bernard working in Java recommended that all infected leaves be cut off and burned *in situ*; that there be constant watch for the reappearance of the disease; that planting a great number of trees of the same age at the same time be avoided so that a large number will not reach the susceptible age at the same time; and that trees be sprayed with 2-2-50 Bordeaux mixture at intervals of fifteen days, taking care to reach the youngest leaves.

Munro and Brown (1920) recommend the cutting off of slightly and seriously affected leaves. Diseased leaves as well as dead palms should be burned right on the spot.

Sampson (1923) recommends that Bordeaux-resin-soda mixture instead of ordinary Bordeaux mixture should be used for spraying at fortnightly intervals.

Reinking (1918) states that in severe cases of infection of young trees, spraying with Bordeaux mixture is effective. He also advises burning dead and diseased leaves to reduce sources of inoculum.

Stockdale (1906) recommends the destruction and weakening of the fungus, probably by the use of fungicides and by inducing vigorous growth of the trees through manuring, proper cultivation, and irrigation or drainage. Inducing vigorous growth of trees seems to be of great importance. It

appears that in places best suited for coconuts and where trees are vigorous that the disease is not common. On account of the great number of spores produced by the fungus, Stockdale suggests that all dead trees should be cut down and all of their parts collected and burned.

SUMMARY

1. The gray spot, or blight of coconut is the most common leaf disease of this palm in the Philippine Islands.

2. The damage caused by the disease in the Philippines and elsewhere is very difficult to determine.

3. The outward manifestation of the disease when young is the presence of small yellowish brown, circular to oblong and more or less depressed spots which are about a millimeter in diameter. When old, the spots may be up to five centimeters long and one centimeter wide. The central portion of the spot becomes gray and soon contains black minute dot-like bodies consisting of the fruiting structures of the fungus.

4. The gray spot, or blight of coconut in the Philippines is caused by a species of *Pestalozzia* which is considered identical with *P. palmarum* Cke.

5. The mycelium is densely granular, septate and somewhat irregular in outline when young, but when old the granules disappear. The hyphae are thin-walled, branched and some of the adjacent cells have a tendency to fuse.

6. The acervuli are sub-epidermal on the host and erumpent but are formed on the surface of the media in culture.

7. The spores are spindle-shaped, somewhat curved, tapering at both ends, with hyaline terminal cells, one of which, the distal end, bears appendages and bulges in the region of the colored cells. The spores usually have from one to three hyaline appendages, though on the leaves and in pure culture on soybean agar they may have from one to four. They usually contain three brown cells, though some contain from one to five and one hyaline pedicel. The spores are $11.7-28.3 \times 3-3-6.7 \mu$ in pure culture on oatmeal agar, soybean agar, and corn meal agar and $14.4-21.6 \times 4.7-7.2 \mu$ on the leaves. Generally, they germinate by the production of germ tubes from the last brown cell towards the proximal hyaline end.

8. The spores germinate in about four hours and twenty-three minutes in sterile rain water. Field inoculations show that the Philippine *Pestalozzia palmarum* is capable of infecting, besides coconut, cabo-negro (*Arenga saccharifera* Wurm.), pugahan (*Caryota cumingii* Blume), buña (*Areca catechu* L.), royal palm (*Oreodoxa regia* HBK.), and *Phycosperma macarthurii*. The fungus penetrates the host tissue only through wounds and the hyphae in the leaves are intercellular.

9. The fungus may be carried from one place to another with green or dead leaves by man. The spores may be spread chiefly by wind and

rain. The fungus lives from one season to another as mycelium within the tissues of the leaves.

10. Spraying young trees with standard Bordeaux mixture using resin-salsoda sticker, cutting and burning infected leaves *in situ* seem to be appropriate measures for controlling gray blight of coconut in young plantations and in nurseries. Inducing production of vigorous plants is said to enable coconuts to resist infection.

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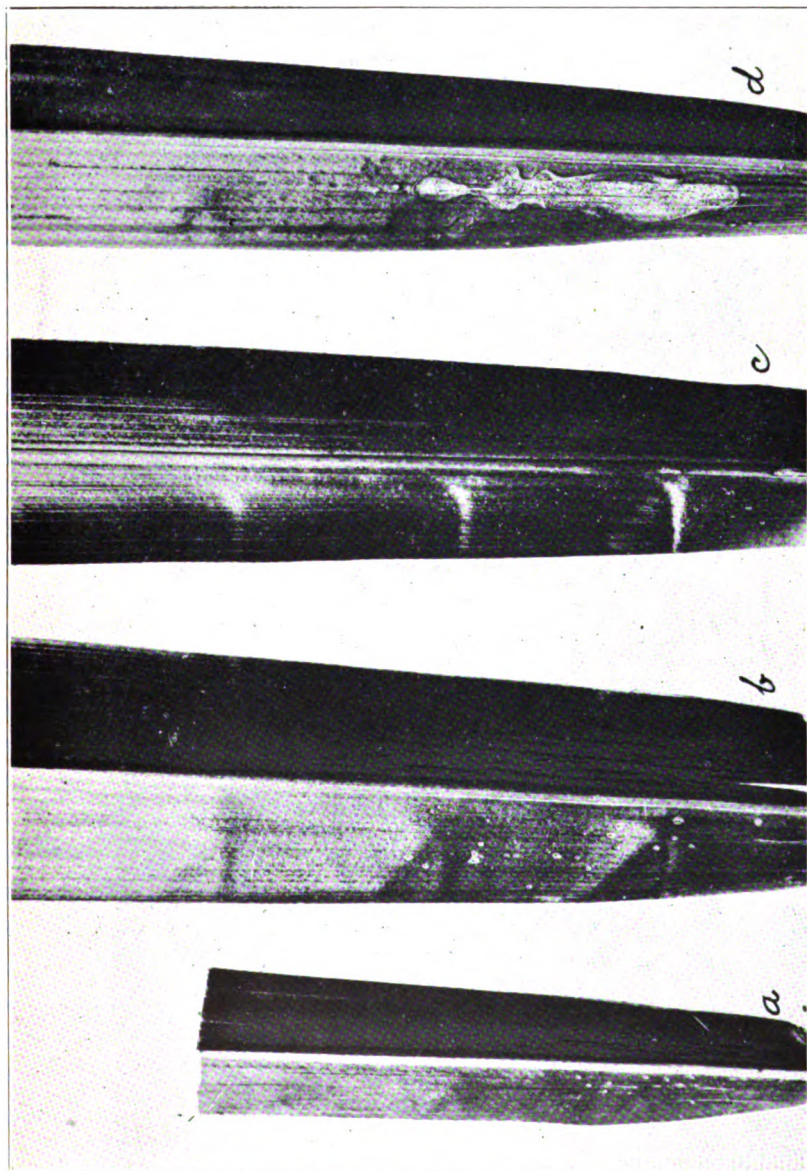


PLATE I

a. Portion of a pinna of coconut wounded with sterile needle pricks and used as check in the inoculation experiments. Nearly natural size. *b.* Portion of a pinna inoculated through wounds showing 15-day old infection. Nearly natural size. *c.* Portion of a pinna inoculated through wounds showing 31-day old infection. Nearly natural size. *d.* Portion of a pinna inoculated through wounds showing lesions of 78-day old infection. Note that the spots have coalesced and fringing bodies are present on the dead gray patches. Nearly natural size.

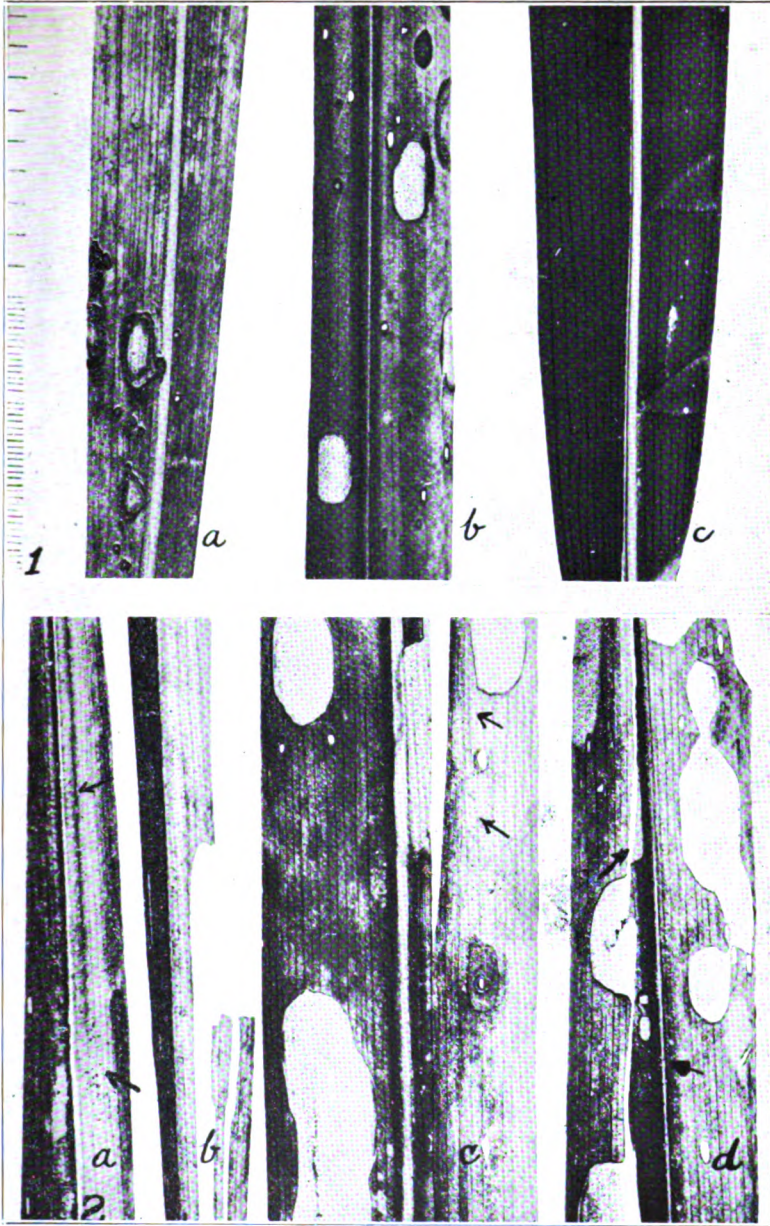


PLATE II

Fig. 1a. Portion of a pinna showing the spots produced by artificial inoculation through wounds. Slightly reduced. b. Portion of a pinna showing the spots produced in natural infection. Compare lesions with those on figure 1a. Slightly reduced. c. A control pinna showing absence of lesions. Slightly reduced.

Fig. 2a, b, c, d. Portions of old pinnae showing the distribution of the minute fruiting bodies on the upper surface and on the midrib as indicated by the arrow heads. This is very common on old infected leaves in field infection. These minute bodies appear black but in the picture some of them appear white because of the light. Natural size.

(All photographs by the Photographic Division, Department of Agronomy, College of Agriculture, Los Baños, Laguna, P. I.)

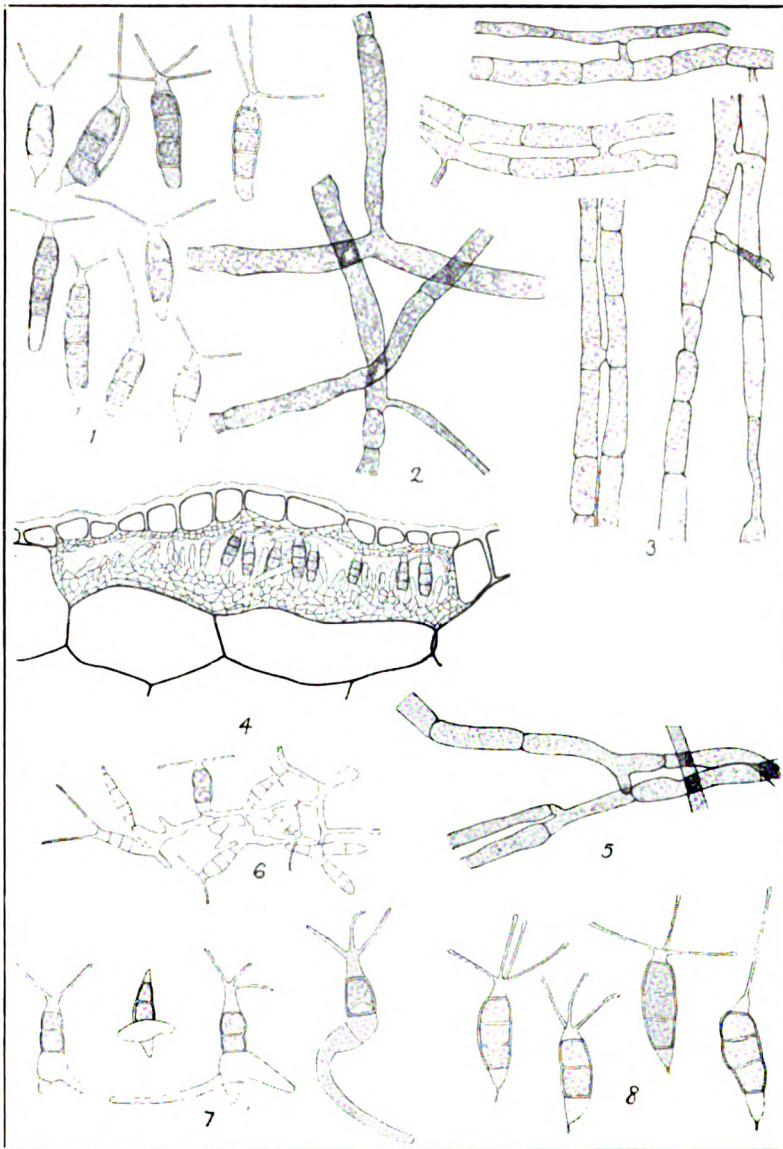


PLATE III

1. Conidia from pure culture showing from one to four appendages and one to five colored cells. About 627 $\times$.
 2. Young submerged hyphae from pure culture. About 665 $\times$.
 3. Old submerged hyphae from pure culture showing the fusion of hypha. (a) About 616 $\times$, (b) about 626 $\times$.
 4. Free hand section through a young acervulus on a leaf from natural infection showing position of the conidia in the subepidermal fruiting body. About 393 $\times$.
 5. A young aerial mycelium from pure culture. About 665 $\times$.
 6. Germ tubes with the young secondary conidia arising from the mother spore. About 453 $\times$.
 7. Germinating conidia showing the different ways of issuing germ tubes. About 560 $\times$.
 8. Conidia from the leaves with from one to four appendages and blunt apical ends and two to three colored cells). About 733 $\times$. Spores containing only one colored cell are also produced in the field.
- (All drawings were made under the oil immersion objective of a DDS Bausch and Lomb microscope using a camera lucida.)

A STUDY OF THE FEEDING, CARE, AND MANAGEMENT OF NATIVE CALESA HORSES AT LOS BAÑOS, LAGUNA¹

ANTERO P. INCIONG

The objects of this investigation were: (a) To find out the kinds of feeds given calesa horses in Los Baños and the amounts consumed; (b) to investigate the care and management of these horses; and (c) to find out the amount of work performed by them.

The work was carried out in Los Baños, Laguna, from July, 1925, to December, 1926, covering a period of one year and five months.

MATERIALS

Animals

Twenty-five calesa horses ranging in age from three to fourteen years were used in this work. Of these horses, eighteen were stallions, five were mares, and two were geldings. These animals averaged in age, 6.8 years, in height, 123.76 centimeters, and in weight, 206.06 kilograms. (See table 1.)

Scales

The horses were weighed on a pit stock scale.

A spring balance was used in determining the weight of the feeds consumed and left over by the horses.

PROCEDURE

In selecting the twenty-five animals for this investigation, thirty-one were examined as to health and condition and the sickly animals were eliminated. The habits of feeding and thriftiness of the thirty-one were observed for a few days so that those with owners that were unusually careless, ignorant, or brutal could be eliminated.

In determining the consumption of feeds, the weight of the feed given as well as that left in the manger was taken, the difference representing the amount consumed. This was done at each of the three daily feedings. The animals were weighed for three consecutive days at the beginning and end of observation. The work performed in kilometers daily was determined and recorded. Other observations on the management of each animal, such as shoeing, grooming, bathing, clipping, and trimming of mane and tail and the condition of the stables were also made and recorded.

These observations were made for forty days with each horse.

¹ Thesis presented for graduation, 1927, with the degree of Bachelor of Agriculture from the College of Agriculture No. 269; Experiment Station contribution No. 548. Prepared in the Department of Animal Husbandry under the direction of Dr. Valente Villegas.

DISCUSSION OF RESULTS

Feeding

Method. Horses that were fed only in the stable were given feed at least three times a day—morning, noon, and afternoon. Horses that were pastured part of the time were given feed in the stable irregularly. As a general rule, feed was given to horses at any time they were returned from work.

Concentrates. The concentrates given to the horses included rice bran, corn, and rough rice. The rough rice was used with only three animals. As may be seen in table 3, the amount of concentrates fed to the horses ranged from zero to an average of 3.3 kilograms a day or 1.6 kilograms for every 100 kilograms live weight. Only two animals observed received an average of more than three kilograms of grain a day, and six horses did not receive any concentrate throughout the whole period of investigation. The majority of the animals received from one to one and five-tenths kilograms of grain a head, daily. Only six horses received a regular supply of concentrates; they were given 2.3 kilograms a day; the remaining nineteen horses were given grain only when work was done by them and corresponding earnings obtained by owners.

During the investigation, corn was given shelled except to one horse which received corn on the cob a part of the time. This grain was given alone and dry. Generally, it was given before the feeding of roughage.

Rice bran was mixed in the water given for drink. This practice is claimed to be advantageous in that a horse will drink more water and consume more rice bran than if each is given alone.

Only three horses (the same animals that were fed rough rice) received molasses. This feed was given in water. It was observed that after they became accustomed to the taste, the animals would drink more of this mixture than of pure water.

Roughage. The most common roughages fed to horses were barit (*Leersia hexandra* Siv.), culape (*Paspalum conjugatum* Berg), and carirawraw (*Digitaria corymbosa* (Roxb.) Merr. As these grasses are very palatable and fine in texture they are very much relished by the animals.

Other grasses and forage plants that were fed were aguingay (*Rottboellia exaltata* Linn. f.), Napier grass (*Pennisetum purpureum* Schum), Para grass (*Panicum barbinode* Trin.), corn forage, cogon (*Imperata cylindrica* Linn. Beauv.), Guinea grass (*Panicum maximum* Jacq.), *Dactyloctenium aegyptium* (Linn.) Richt, *Eleusine indica* (Linn.) Gaertn., *Panicum reptans* Linn., *Merremia emarginata* (Burm. f.) Hallier f, *Alternanthera sessilis* Linn., *Isachne debilis* Rendl., *Panicum colonum* Linn., and *Mimosa pudica* Linn.

Of the twenty-five horses studied, nine were pastured part of the day and the remaining sixteen were fed and cared for in a stable. All the horses fed in the stable all the time consumed on an average 22.24 kilograms of

roughage a head daily, the range being from 17.37 to 31.41 kilograms. Of the animals that were pastured, one was pastured every morning, while the other eight were pastured irregularly. As may be seen in table 3, horse No. 25 was pastured for only two days and only two hours a day, on an average, during the investigation, while horse No. 23 was pastured, on an average, 9.23 hours a day. The others were turned out in the pasture for periods intermediate between these figures.

No definite method of feeding the roughage was followed. The general rule was to give the horses roughage in amounts that they would consume when they came from work. There was observed a general tendency to give the horses an excessive amount of grass, which accounts for the pot-bellied appearance of many of them. Otherwise, roughage was given generally after grain feeding and before watering.

No special preparation of the roughage was made before feeding it, except with conrstalks, which were cut in short lengths to facilitate feeding and induce greater consumption.

Watering. The horses in this study were generally watered only twice a day, and horses Nos. 4 and 5 were not even watered days they were idle and the weather was rainy. Clean stream water was used in all cases.

Salting. Seven horses were salted, but irregularly. The salt was given in water when rice bran was not available. The other eighteen animals were not salted.

Work performed

The work performed by these horses is expressed in the number of kilometers covered in driving the animals. This valuation is but an approximation and is used here for practical purposes. Many factors, such as the size and kind of vehicle, the number of passengers carried, grade and nature of road surface, temperament of the driver, climate, etc., enter into the calculation of any standard value of work done by calesa horses.

It may be seen, in table 3, that the minimum amount of work done by any horse was on the average 4.3 kilometers a day. The maximum average distance covered daily was 21.9 kilometers. The general average distance made by all the twenty-five horses was 10.1 kilometers daily. The usual number of passengers carried was two.

Relation of feed consumption to work done and the condition of horses

During the 40 days of observation on each of the twenty-five horses only six recorded an increase in weight. The increase ranged from 0.5 kilogram to 3.6 kilograms. The weight of one horse remained stationary. The other eighteen had decreased in weight from 2.2 to 6.5 kilograms by the end of the period of observation. The six horses that registered increases in weight each received, on an average, 20.7 kilograms of roughage and 1.9 kilograms of concentrates daily, and each traveled, on an average, 12.6

kilometers daily. The horses that registered a decrease in weight each received, on an average, 20.8 kilograms of roughage and 0.8 kilogram of concentrates daily, and each traveled an average of 9.4 kilometers, daily.

Of special interest in this investigation are the cases of horses Nos. 6, 8, and 19; these animals performed a large amount of work and still had made gains in weight at the end of the investigation. Horses Nos. 6 and 8 belong to one owner, and the increase in weight indicated unusual ability on his part to care for and feed his horses. Horse No. 6 covered an average of 21.86 kilometers a day and had increased 2.4 kilograms in weight during the investigation. This animal received daily an average of 19.44 kilograms of roughage and 3.37 kilograms of concentrates. Horse No. 8 made an average of 12.6 kilometers a day and gained 1.4 kilograms in weight. The feed given to her daily amounted to an average of 20.33 kilograms of roughage and 2.83 kilograms of concentrates. Horse No. 19 covered an average of 16.7 kilometers a day and registered an increase of 2.3 kilograms during the investigation. He received daily an average of 20.53 kilograms of roughage and 3.25 kilograms of concentrates.

It may be seen also in table 3 that six horses did not receive any concentrate during the 40 days of observation, but traveled on an average 8.12 kilometers a day. This management resulted in reduction in weight amounting, at the end of the investigation, to an average of 5.18 kilograms a head.

The favorable effect of adequate feeding, especially grain feeding, is very apparent in these observations. Undoubtedly the reduction in weight of some of the horses was, in some measure, due to bad treatment received from cruel, inconsiderate drivers. It is not uncommon to see drivers whip their horses and jerk the reins unnecessarily, thus keeping the animal irritated and nervous. They often drive their horses faster than circumstances require. If the drivers were better trained, unquestionably, in many cases, the horses would be in a better condition.

Grooming

Eight horses were cleaned twice a day according to the general procedure of cleaning horses. The owners of nineteen horses used curry-comb and brush and the owners of seven horses used a *baò* (coconut shell) with serrated edges in place of curry-comb, and a piece of rag in place of a brush.

The horses were cleaned regularly but not as thoroughly as good care demands. Only the upper part of the body was cleaned leaving the legs and the belly and the head untouched, or only partly cleaned.

Bathing

All the horses, except two, were bathed some time during the period of investigation. Some animals were bathed every day for certain periods and the rest of the time only occasionally. Some of the horses were bathed only at long intervals. As a general rule, the horses were bathed after they

had performed strenuous work or when the body was so dirty as to require general cleaning. It was observed that soap was used in bathing six horses, especially in washing parts that were soiled with manure and materials of like nature. The brush was commonly used in the cleaning processes, but when the owner had none the *bao*, or coconut shell, was used. The horses were taken to the river for bathing.

Trimming of mane and tail, and clipping of body hair

As a general rule, the trimming of the mane and tail and the clipping of the body hair of the animals were not done regularly, consequently the horses investigated were seldom attractive in appearance.

During the period of observation only twelve horses were trimmed, and only once, none were clipped. Possibly this lack of clipping was due to the fact that this is usually done about the beginning of the dry season when the body hair of the horse is longest; this investigation was carried on during the rainy season.

Shoeing

Inasmuch as the period of observation on each animal was only for forty days, it was not possible to determine the interval at which each horse was shod. However, all the horses studied were shod once during the forty days of observation. Owing to the fact that all of these horses were driven on macadamized roads, there was no chance for the hoof to grow too long before the shoes wore out. The cost of shoeing horses in Los Baños is ₱0.25 a foot. One man who owned three horses did his own shoeing.

Stables

All the horses were found to be housed in insanitary stables. No solid floor was provided for the horses except in the case of four; most of the time the animals stood in mud and manure. In the case of four horses the condition was worse, as they were tied to trees without any provision being made for shelter. The stable of one horse was found to be sanitary and safe for the horse, and gave sufficient freedom for the animal to move around.

SUMMARY OF OBSERVATIONS

1. Twenty-five calesa horses owned and used in Los Baños Municipality were observed in this study, eighteen of which were stallions, five were mares, and two were geldings.
2. The average age of the horses was 6.76 years, the range being from 3 to 14 years.
3. The average height was 123.76 centimeters (48.72 in.) and the average weight, 206.06 kilograms (454.28 lbs.)
4. The horses were generally fed three times a day—morning, noon, and afternoon.

5. The common concentrates given to the horses were rice bran and corn, and occasionally rough rice.

6. The common roughages given to the horses were barit (*Leersia hexandra* Siv.), culape (*Paspalum conjugatum* Berg), carirawraw (*Digitaria corymbosa* Roxb.), corn forage, and mixed pasture grasses.

7. The average consumption of roughage by unpastured horses was 22.24 kilograms a head a day.

8. The average consumption of grain by horses fed concentrates regularly was 2.3 kilograms a head a day.

9. There was no regularity in the feeding of roughage or grain.

10. The horses were generally watered only twice a day after feeding.

11. The animals were salted sparingly and irregularly, and a number received none at all.

12. The average distance covered by the horses was 10.14 kilometers a day.

13. Twenty-four per cent of the horses had increased in weight and seventy-two per cent had decreased in weight at the end of observation. Four per cent did not change in weight.

14. The curry-comb and the brush were generally used for cleaning the horses. Grooming was done in a haphazard way.

15. The horses were bathed very irregularly.

16. The trimming of horses was done only occasionally.

17. The horses were shod at reasonable intervals.

18. Very poor and insanitary stables were provided for the horses.

TABLE 1
Showing sex, color, age, and size of horses

HORSE NO.	SEX	COLOR	AGE ^a	HEIGHT	INITIAL WEIGHT
			<i>years</i>	<i>cm.</i>	<i>kgm.</i>
1	Stallion	Bay	6	128.2	214.6
2	"	Black	3	125.4	195.9
3	"	Cream	5	118.2	190.9
4	"	Buckskin	4	120.3	198.2
5	"	Black	8	124.5	201.3
6	Gelding	Bay	8	134.3	248.1
7	Stallion	Skewbald	3	128.0	202.2
8	Mare	Roan	8	123.2	193.0
9	Stallion	Buckskin	5	121.5	217.2
10	"	"	7	127.0	218.0
11	Gelding	Bay	10	128.1	251.0
12	Stallion	Buckskin	6	125.3	230.2
13	"	Gray	14	115.2	192.7
14	"	Bay	6	119.0	173.6
15	Mare	Bay	10	125.5	227.4
16	Stallion	Buckskin	9	126.0	204.5
17	"	"	8	126.5	201.3
18	"	Black	7	117.0	187.3
19	"	Bay	5	121.5	236.3
20	"	Skewbald	11	120.2	184.5
21	Mare	Gray	6	120.5	186.2
22	Stallion	Buckskin	4	124.0	205.0
23	Mare	Bay	8	118.2	197.0
24	Stallion	Gray	3	128.0	190.0
25	Mare	Bay	6	128.5	205.2
Average.....			6.80	123.76	206.06

^a The age was obtained from the certificate of ownership.

TABLE 2
Showing proximate constituents of feeds used ^a

SAMPLE	MOIS- TURE	CRUDE FATS	ASH	PRO- TEINS	CRUDE FIBER	CAR- BOHY- DRATES	CALO- RIFIC VALUE PER 100 GRAMS
<i>Concentrates</i>							
Rice bran No. 1 ^b	11.51	3.52	14.16	7.60	25.86	37.35	215
Rice bran No. 2.....	13.26	9.30	14.78	8.19	13.06	41.41	290
Corn.....	15.68	3.41	1.81	8.19	1.72	69.19	350
Molasses.....	55.10	0.15	3.47	0.78	—	—	—
<i>Roughage</i>							
Barit (<i>Leersia hexandra</i> Siv.)....	70.91	1.55	4.63	1.81	8.70	12.40	70
Corn fodder.....	17.83	0.66	1.52	0.60	4.63	74.76	315
Culape (<i>Paspalum conjugatum</i> Berg).....	69.05	0.67	3.19	1.82	8.54	16.73	80
Guinea grass.....	66.43	0.83	4.28	1.25	11.52	15.69	75
Carirawraw (<i>Digitaria corymbosa</i> Roxb.).....	71.57	0.76	4.42	2.01	8.38	12.86	70
Napier grass.....	80.16	1.17	3.70	2.28	4.97	7.72	50
Aguingay (<i>Rottboellia exaltata</i> Linn. f.).....	63.88	1.17	4.57	3.38	10.81	17.19	90
Pasture grasses.....	70.82	2.56	3.23	3.03	9.48	10.88	80

^a Analysis performed in Analytical Laboratory, Chemistry Department, College of Agriculture.

^b This kind of rice bran is rougher and less palatable than rice bran No. 2.

TABLE 3

Showing average daily feed consumption and pasturage, daily work performed, and condition of horses at end of investigation

HORSE NO.	ROUGHAGE		CONCENTRATES		PASTURAGE		WORK DONE	GAIN OR LOSS IN WEIGHT
	Day	Night	Day	Night	Days	Hours a day		
	kgm.	kgm.	kgm.	kgm.			km.	kgm.
1	7.97	11.51	1.05	0.55	—	—	16.55	-3.2
2	6.45	10.92	1.07	0.37	—	—	13.75	-2.7
3	9.60	13.18	0.76	0.04	—	—	16.82	+0.5
4	8.97	11.54	0.68	0.01	—	—	14.50	-6.4
5	15.86	15.55	0.14	—	—	—	6.00	-3.2
6	9.55	9.89	0.92	2.45	—	—	21.85	+2.4
7	14.55	15.07	0.58	0.11	—	—	9.45	-4.6
8	10.70	9.63	0.50	2.33	10	3.40	12.60	+1.4
9	9.79	11.44	0.50	0.50	3	2.33	6.80	-5.2
10	8.36	11.34	—	—	21	2.10	7.58	-5.5
11	3.56	6.03	0.42	0.64	38	5.55	5.10	-3.0
12	7.60	8.38	0.41	0.75	16	4.93	5.03	-3.2
13	9.06	14.18	0.76	0.88	—	—	11.92	-2.2
14	9.29	10.86	0.73	0.88	—	—	9.00	-6.5
15	9.79	11.69	0.68	0.98	—	—	12.85	-3.4
16	11.29	11.31	0.63	0.50	3	1.33	6.45	same
17	11.97	13.38	—	—	7	2.71	7.77	-4.0
18	10.65	11.71	0.63	0.55	—	—	4.75	+3.6
19	10.22	10.31	2.00	1.25	—	—	16.70	+2.3
20	11.62	12.07	—	—	—	—	7.85	-6.0
21	11.36	11.61	—	—	—	—	7.05	-5.2
22	10.93	11.21	0.51	0.51	—	—	10.40	-3.0
23	—	10.88	—	—	40	9.23	8.05	-4.0
24	9.48	9.27	0.14	0.16	—	—	4.35	+3.5
25	9.61	10.98	—	—	2	2.00	10.40	-6.4
Average.	9.93	11.36	0.69	0.75	15.6	3.73	10.14	-2.67

THE CHEMICAL COMPOSITION OF PHILIPPINE FISHES¹

AMADO N. BALAGTAS

INTRODUCTION

Importance of fish in the diet

Fish occupies an important place in the Filipino dietary. Filipinos, in general, especially those living along the sea coasts and interior rural districts, subsist largely on rice, fish, and vegetables. Even in the cities, fish is always in great demand. According to the Statistical Bulletin of the Philippine Islands (1925) the capital invested in fisheries in 1918 was ₱9,613,907 and the value of the catch amounted to ₱8,692,401. In spite of this large amount of invested capital, the importation of fish in the same year was ₱5,212,350. (Census of the Philippine Islands, 1921.)

The results of the investigation reported by Roxas (1922) show that the diet of the Filipinos is probably deficient in proteins. As fish is the principal source of protein supply in their diet, the importance of knowing which fishes are best for food is obvious.

Gibbs and Agcaoili (1912) reported some analyses of dried fishes and some minor Philippine fish foods, as *bagoong*, etc., but no publication on the chemical composition of fresh Philippine fishes is available. Adriano and Tavanlar (1925) in their study of Philippine foods determined the calcium oxide content of the ash of some fishes.

Object of the present work

This work was undertaken to find the possible nutritive value of some Philippine fishes.

Time and place of the present work

This work was begun in April, 1926, and closed in February, 1927. All analyses were performed in the Advanced Laboratory of the Department of Agricultural Chemistry, College of Agriculture, Los Baños.

MATERIALS AND METHODS

Description of materials

Most of the materials used were obtained from the local (Los Baños) and Manila markets. A few species were secured from Pampanga.

¹ Thesis presented for graduation, 1927, with the degree of Bachelor of Science in Agriculture from the College of Agriculture No. 270; Experiment Station contribution No. 549. Prepared in the Department of Agricultural Chemistry under the direction of Dr. F. O. Santos.

Samples from Manila and Pampanga were packed in ice to prevent decomposition. The sampling was done within 24 hours after the fish were caught.

The samples were identified by H. R. Montalban, of the Bureau of Science.

The following descriptions of the materials apply to the representative samples preserved for identification.

References on the distribution of fish were taken from Seale's *The Fishery Resources of the Philippine Islands* (1908).

Anchovy (*Anchovia commersoniana* Lacépède); dilis (Tag.); monamon (Ilocano); anak-bat (Moro). This species is the most common of all the anchovies found in the Philippine waters. It is found in great numbers along the shores of the islands. This fish is usually dried or made into *bagoong*.

The sample preserved was a small fish 10 cm. in length and 1.1 cm. in width. The body was almost transparent with very thin scales. The head was small. The sample weighed 7 grams.

Barracuda (*Sphyræna acutipinnus* Day). Barracuda abounds in all Philippine waters. It can be found in the Manila markets throughout the year.

The body of the preserved sample was long and cylindrical, measuring 20 cm. in length and 2 cm. in width. It was covered with small scales. The weight of the sample was 37 grams.

Barracuda (*Sphyræna jello* Cuv. et Val.); babayo (Tag.). Barracuda is a salt water fish. It is one of the largest fish found in Manila markets. It is seldom sold whole, but in cut portions.

The body of the preserved sample was slightly compressed laterally. It measured about 49 cm. in length and 8.5 cm. in width. The body was covered with white scales. The head was small. The sample weighed 573 grams.

Bastard shad (*Konosirus thrissa* Osbeck); kabasi (Tag.). This fish can be procured in Manila markets at any time of the year. Large numbers are caught in Manila Bay. They are sold either fresh or smoked (*tinapa*).

The sample preserved was laterally compressed and measured 20 cm. in length and 8 cm. in width. It was covered with white scales. The weight of the sample was 110 grams.

Caesio (*Caesio chryeozona* Kuhl and Van Hassell); dalagang-bukid (Tag.). This is a salt water fish.

The preserved sample measured 20 cm. long and 5.5 cm. wide. It was slightly compressed laterally. The dorsal surface was pink. The head was small. The sample weighed 93 grams.

Catfish (*Arius* sp.); kandule (Tag.); gagúe (Moro). This fish lives in both salt and fresh water lakes and rivers. It is found in all parts of the

Islands. On account of a peculiar feeding habit, it is not much liked by the well-to-do Filipinos.

The preserved sample was cylindrical in form and measured 36 cm. in length and 6.5 cm. in width. It is a scaleless fish but the skin is thick, dark on the dorsal surface and white ventrally. The head is large in comparison with the size of the body. The sample weighed 227 grams.

Catfish (*Clarias batrachus* Linn.); hito (Tag.). This variety of fish is abundant in small ponds and rice paddies where water remains stagnant for some time. It is widely distributed in the Islands. It is a fresh water fish.

This is a black, scaleless cylindrical fish. The preserved sample was 30 cm. long and 4.5 cm. wide. The head was rather large in proportion to the body. The sample weighed 143 grams.

Climbing perch (*Anabas testudineus* Bloch); tinikan (Tag.); liualu (Pamp.). This fish is common in all parts of the Islands. It inhabits fresh water lakes and rivers, usually the shallows.

The body of the sample was laterally compressed and was covered with green scales. It was 12 cm. long and 4 cm. wide. The head was moderately large in comparison with the body. The sample weighed 30 grams.

Croaker (*Johnius belengeri* Cuv. et Val.); abo (Visayan). The croaker is most abundant along the shores of the Southern Islands. It is a salt water fish.

The sample measured about 16 cm. in length and 4.5 cm. in width. The body was laterally compressed. The head was small and the body was covered with small scales. The sample, preserved, weighed 57 grams.

Drepane (*Drepane punctata* Gmelin); mayang (Tag.). This is a salt water fish found in almost all parts of the Islands.

The sample was almost circular in form and compressed laterally. It was 12 cm. long and 10 cm. wide. The body was covered with dirty green scales with irregular black spots on both sides. The weight of the sample was 75 grams.

Drum (*Umbrina russelli* Cuv. et Val.); apahap (Tag.). This is one of the most important commercial fish in the Philippines. It is abundant in rivers and in most Philippine bays and seas. It is one of the fishes that brings the highest price in the market.

The preserved sample was compressed laterally. It was broad and covered with large white scales. It was 35 cm. long and 10 cm. wide. The head was small in proportion to the body. This sample weighed 573 grams.

Flathead (*Platycephalus indicus* Linn.); sunog (Tag.); biang-sudsod (Pamp.). It is found in Philippine lakes and rivers all the year round.

The body of the sample was a little flat dorso-ventrally. It was 33 cm. long and 4 cm. wide at the region of the trunk. The dorsal surface was dark with a green tinge, the ventral was white. The head was flat and moderately small. The weight of the preserved sample was 201 grams.

Flounder (*Pseudorhombus neglectus* Bleeker); palad (Tag.). This fish is widely distributed and is found in large numbers along the shores of the Ilocos provinces.

The preserved sample was laterally compressed and was covered with fine brown scales. The length was 14 cm. and the width, 7 cm. The sample weighed 24 grams.

Goby (*Glossogobius giurus* Hamilton-Buchanan); biang-puti (Tag.); kolapo (Moro). This fish is one of the most common species of the family Gobiidae. It is found in all parts of the Islands; is especially abundant in fresh-water lakes and rivers where it is caught with drift nets and by hook and line. It is also taken in lakes and rivers where the water is brackish.

The body of the preserved sample was cylindrical and covered with light yellow scales. The length was 22 cm. and the width, 4.5 cm. The head was moderately large. It weighed 81 grams.

Goby (*Oxyurichthys opthalmonema* Bleeker); tuñgo (Tag.); bianguayan (Pamp.). This fish is abundant in rivers where it is caught in large quantities. It is cheap and is usually made into *bagoong*.

The sample was a small fish, measuring 11 cm. in length and 1.5 cm. in width. The body was covered with fine scales and the head was moderately small. The weight of the fish was 7 grams.

Grunt (*Pristopoma hasta* Bloch); ayuñgin (Tag.); lagohot (Moro); licauc (Pamp.). This fish is always for sale in the Manila markets. Although it is a salt water fish, it is found in abundance in Laguna de Bay, a fresh water lake.

The preserved sample was a small fish about 7 cm. long and 4.5 cm. wide. It was laterally compressed. The body was covered with dirty green scales. The head was small. The weight of the sample was 21 grams.

Grunt (*Pomadasis argyreus* Cuv. et Val.); besugo (Tag.). The sample was a small fish measuring 8.5 cm. in length and 2.5 cm. in width. It was laterally compressed and the body was covered with scales. The head was large in proportion to the body. The sample weighed 14 grams.

Half-beak (*Hemiramphus* sp.); buguing (Tag.). The body of the preserved sample was cylindrical and measured 23 cm. in length and 2 cm. in width. The head was small with a long snout. The weight of the sample was 34 grams.

Herring (*Harengula moluccensis* Bleeker); tunsoy (Tag.); tamban (Moro). This is a salt water fish. It is found along the shores of all the islands. Large numbers are caught in Manila Bay throughout the year, with especially heavy catches during May and June.

The sample was compressed laterally. It was 11 cm. in length and 2.2 cm. in width. The head was small and the body was covered with white scales. The weight of the sample preserved was 10 grams.

Japanese mackerel (*Scomber japonicus* Houttuyn); hasa-hasa (Tag.). It is found in all shoals in the Islands and comes to Manila Bay in March.

It is rarely caught in inland rivers. This species is especially common about the Cuyo group of islands and along the shores of Palawan. It is one of the popular food fish, always selling readily in the market.

The body of the sample was white and compressed laterally. It was about 15 cm. in length and 5 cm. in width. The head was large in proportion to the body. The sample weighed 41 grams.

Leather Jack (*Scomberoides tol* Cuv. et Val.); cas-sisung (Tag.); lapis (Pamp.). This is a salt water fish caught in quantities in the South China Sea about the region of Palawan.

The sample was broad, compressed laterally and covered with fine yellow scales. It was 37 cm. long and 15 cm. wide. Its head was large. The sample weighed 655 grams.

Marine eel (*Muraenesox cinereus* Forskol); palos (Tag.). This eel is primarily a marine species, but it also occurs in great abundance in the mouth of rivers, migrating up stream as far as the tides are felt.

The body of the preserved sample was cylindrical and measured 38 cm. in length and 2 cm. in width. The head was small and the body devoid of scales. The weight of the sample was 42 grams.

Milkfish (*Chanos chanos* Forskol); baños (Tag.); bangellus (Moro). The milkfish is one of the most important commercial fish in the Philippines. It ranges from the northern to the southern part of the Islands. It is raised in ponds which occupy thousands of hectares of land. As the fish lives in salt water, the ponds are located along the banks of brackish rivers and shores of bays and seas.

The sample preserved measured about 23 cm. in length and 7 cm. in width. The body was covered with white scales and was slightly compressed laterally. The sample weighed 391 grams.

Mudfish (*Ophicephalus striatus* Bloch); dalag (Tag.); bundaqui (Pamp.). This fish is found in fresh water lakes, small ponds and other low places where there is water. Large numbers are caught in rice fields during the rainy season. This fish is widely distributed in the Islands and is much liked by Filipinos.

The preserved sample was cylindrical and covered with black scales along the dorsal surface and with white scales along the abdominal region. It was 31 cm. long and 5 cm. wide. The head was large. The weight of this sample was 235 grams.

Mullet (*Mugil cephalus* Linn.); banak (Tag.); balanak (Pamp.). The mullet is the most common species belonging to the family Mugilidae that is found in the Philippines. It feeds on vegetables and is migratory in habit.

The sample was 15 cm. long and 5 cm. wide. It was slightly laterally compressed. The body was covered with white scales. The head was small in proportion to the body. The sample weighed 96 grams.

Nemipterus (*Nemipterus* sp.); kulisig (Tag.). The body of the preserved sample was compressed laterally and covered with scales. It was 9.5 cm. in length and 2.5 cm. in width. The head was moderately small. The weight of the sample was 12 grams.

Pompano (*Caranx malabaricus* Bloch and Schneider); talakitok (Tag.). This is a salt water fish and is one of the most important commercial fish in the Islands. It is plentiful in Manila markets.

The preserved sample was compressed laterally, measuring 12 cm. in length and 5 cm. in width. The head was large in proportion to the body. The sample weighed 26 grams.

Porgy (*Sparus calamara* Russell); bakoko (Tag.); gaud-gaud (Moro). This fish is plentiful in Manila markets. It is caught in rivers and lakes with hook and line and with nets.

The body of the sample preserved was laterally compressed and covered with white scales. The length was 14 cm. and the width 8 cm. The sample weighed 85 grams.

Sardine (*Sardinella longicops* Cuv. et Val.); tamban (Tag.). This species of Clupeidae, as the tunsoy, is common in Manila Bay during some seasons of the year; it is most abundant during the months of May and June. This fish is usually smoke-dried and sold as *tinapa*.

The length of the preserved sample was 16 cm. and the width 3.5 cm. The body was laterally compressed and covered with white scales. The sample weighed 46 grams.

Scatophagus (*Scatophagus argus* Gmelin); kitang (Tag.). This fish lives in both salt and fresh water. It is found along the shores of all the islands.

The preserved sample was almost circular in shape and laterally compressed. It was 9 cm. long and 6 cm. wide. The head was small and the body covered with fine scales. The skin was thick. The color was dirty green with black spots on either side of the body. The sample weighed 22 grams.

Snapper (*Hemipterus japonicus* Bloch); kulisic (Tag.). The snappers are found in all Philippine waters but are most abundant in the southern waters along the coast of Zamboanga.

The preserved sample was compressed laterally, measuring 15 cm. in length and 4.5 cm. in width. The head was rather large in proportion to the body. The sample weighed 45 grams.

Tarpon (*Megalops cyprinoides* Broussonet); buan-buan (Tag.). This little pink fish is abundant in Manila Bay. It is an important commercial fish and much liked as food.

Therapon (*Therapon puta* Cuv. et Val.); bugaong (Tag.). This is a salt water fish.

The sample preserved was laterally compressed. It was 12 cm. long and 3 cm. wide. The head was small and the body was covered with fine

scales. Two dark lines run lengthwise on each side. The sample weighed 19 grams.

Methods of analysis

The methods used for the different analyses were taken from the Official and Tentative Methods of Analysis compiled by the Association of Official Agricultural Chemists (1920).

Sampling. To prevent any considerable loss of moisture, sampling was done as quickly as possible. The fish were prepared while fresh.

Several fish were weighed, the number depending on the size of the materials used. Then the scales, fins, head, and internal organs were removed. The flesh was sliced dorso-ventrally. The weight of the vertebral column and the adhering ribs was excluded from the weight of the edible portion.

The flesh thus obtained was weighed and ground in a meat grinder into fine particles and then thoroughly mixed. This ground material was quartered and a representative sample was taken for analysis.

Edible portion. Analyses were made of the edible portion only. The percentage of the edible portion was computed by taking the initial weight of the whole fish and the final weight of the flesh obtained therefrom. From the data obtained, the percentage of edible portion was calculated.

Moisture. Approximately 2 to 10 grams of the samples were weighed in a crucible and dried to constant weight between 100° and 105° C. The loss in weight from drying is the moisture.

Ash. The moisture-free samples in moisture determination were ignited until the residue was free from carbon particles. The difference between the weight of the ash plus the crucible and the constant weight of the crucible represents the ash.

Crude fiber. The weighed samples (5 to 10 grams) were placed in a 500 cc. reflux flask and boiled for 30 minutes with 200 cc. of 1.25 per cent sulfuric acid solution. The mixture was filtered through a cloth filter, and the residue washed until free from acid. The residue was returned to the same flask and treated with 200 cc. of 1.25 per cent boiling sodium hydroxide solution. Boiling was continued for 30 minutes. The residue was again filtered and washed until free from alkali, and was then transferred to tared dishes and dried to constant weight. The residue was ignited until free from carbon particles and then weighed. The difference between the first constant weight and the weight after ignition is the crude fiber.

Proteins. The weighed samples (2 to 5 grams) were placed in Kjeldahl flasks and treated with 30 cc. H_2SO_4 and 12 grams of the salt mixture consisting of 10 grams K_2SO_4 and 2 grams CuSO_4 . The acid mixture was digested until clear. After cooling, 300 cc. water were added to the mixture. Enough saturated sodium hydroxide solution was added to make the mixture moderately alkaline. Pieces of mossy zinc were added, and the mixture then distilled. The distillate was collected in a receiving flask containing 50 cc. of standard acid. The excess acid was titrated with the standard sodium hydroxide solution using methyl orange as indicator. The per-

centage of nitrogen thus obtained was multiplied by 6.25 to get the percentage of protein in the sample.

Crude fats or ether extract. Samples of about 2 to 5 grams were weighed in paper thimbles and dried to constant weight. The fat was extracted in the Soxhlet extractor for about 16 hours. Extraction for longer than 16 hours was found unnecessary. The fat free residue in the paper thimbles was then dried to constant weight. The difference between the first and the second constant weights is the crude fats or ether extract.

Carbohydrates or nitrogen free extract. Carbohydrates were obtained by subtracting from 100 the sum of the percentages of moisture, ash, crude fats, crude fiber, and proteins. All undetermined constituents were thus considered as carbohydrates.

Calorific value. The amount of heat or energy liberated by a certain food represents its calorific value. For the calculation of the calorific values, the factors given by Rubner for the fuel values of the different food constituents were used:

Fats.....	9.3 calories per gram
Carbohydrates.....	4.1 " " "
Protein.....	4.1 " " "

Total nutrients. Total nutrients are the sum of the percentages of ash, fats, carbohydrates, and proteins (Langworthy, 1907).

Nutritive ratio. The nutritive ratio represents the ratio between percentage of fats multiplied by 2.25 plus the percentage of carbohydrates and the percentage of proteins.

$$\text{Nutritive ratio} = \frac{(\text{Percentage fats} \times 2.25) + \text{percentage carbohydrates}}{\text{Percentage proteins}}$$

RESULTS

The results of the analyses are given in table 1. The values given are averages of six concordant determinations.

1. Almost 50 per cent of the weight of fish is refuse. Those fish having more or less cylindrical shape contain the higher percentage of edible portion.
2. The percentage of fat decreases as the moisture increases and vice versa.
3. If present, carbohydrates are of insignificant amount in fish.
4. Fish is essentially a nitrogenous material. The protein content is about one-fifth of the total weight of the flesh.

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TABLE 1
Composition of fresh fishes

EDIBLE PORTION	REFUSE	MOISTURE	ASH	ETHER EX- TRACT OR CRUDE FAT	PROTEIN (N X 6.25)	CARBOHY- DRATES	TOTAL NUTRIENTS	CALORIES PER 100 GRAMS	NUTRITIVE RATIO
per cent	per cent	per cent	per cent	per cent	per cent	per cent	per cent	per cent	per cent
72.36	27.65	79.42	1.24	0.70	18.15	0.49	20.58	80	0.11
67.88	32.12	77.86	1.46	3.45	18.63	—	23.54	110	0.42
64.33	35.67	76.74	1.50	1.37	20.63	—	23.50	95	0.15
55.81	44.19	73.72	1.83	4.32	20.00	0.13	26.28	125	0.49
65.12	34.88	79.38	1.21	0.70	19.44	—	21.35	85	0.08
47.14	52.86	79.07	1.49	1.45	17.60	0.39	20.93	90	0.21
56.51	43.49	76.34	1.16	4.75	17.66	0.09	23.66	115	0.61
44.56	55.44	75.19	1.97	5.11	18.56	—	25.64	125	0.62
48.05	51.95	80.90	1.47	1.69	17.40	—	20.56	90	0.22
46.29	53.71	79.69	1.23	1.60	19.44	—	22.27	95	0.19
54.45	45.55	77.17	1.22	1.68	19.93	—	22.83	95	0.19
58.30	41.70	78.41	1.38	1.80	19.47	—	22.65	95	0.21
49.55	50.45	80.13	1.56	0.49	17.42	0.40	19.87	80	0.09
58.10	41.90	79.36	1.46	2.17	17.13	—	20.76	90	0.29
67.50	32.50	81.82	1.91	1.08	15.41	—	18.40	75	0.16
47.04	52.96	79.76	1.56	0.69	18.62	—	20.87	80	0.08
40.54	59.46	75.64	3.52	0.92	17.69	2.23	24.36	90	0.24
60.44	39.56	77.41	1.38	1.24	20.56	—	23.18	95	0.14
67.54	32.46	79.36	1.65	2.45	16.40	0.14	20.64	95	0.35
47.94	52.06	75.30	1.51	2.26	21.42	—	25.19	110	0.24
48.02	51.98	77.70	1.70	1.18	19.44	—	22.32	90	0.14
50.59	49.41	80.28	1.61	0.54	17.78	—	19.93	80	0.07
67.60	32.40	73.54	1.28	3.46	21.40	0.32	26.46	120	0.38
53.92	46.08	77.23	1.31	1.48	20.08	—	22.87	95	0.17
55.79	44.21	76.25	1.36	4.33	18.44	—	24.13	115	0.53
45.46	54.54	78.43	1.87	1.88	17.67	0.15	21.57	90	0.25
50.63	49.37	73.28	1.73	6.25	18.50	0.24	26.72	135	0.77
52.56	47.44	75.78	1.34	1.90	20.96	0.02	24.22	105	0.21
63.83	36.17	75.29	1.60	2.61	19.21	1.29	24.71	110	0.37
38.36	61.64	77.47	2.06	2.31	15.69	2.57	22.53	95	0.50
48.81	51.19	76.55	1.57	4.68	18.02	—	24.27	115	0.58
50.00	50.00	75.76	1.97	4.19	18.96	—	25.12	115	0.50
50.00	50.00	75.40	2.52	2.48	19.72	—	24.72	105	0.28

NOTES ON AN OUTBREAK OF POULTRY EPIDEMIC¹

FRANCISCO GO KEE, M. D.

A very contagious avian disease broke out in Baclaran Poultry Farm in February, 1928. In less than two months, 2,700 of the chickens, mostly laying hens and young pullets, died. This farm is situated on the Manila South Road midway between the towns of Parañaque and Las Piñas, province of Rizal, about a quarter of an hour by automobile from Manila. The farm has been running for about six or seven years.

The stock consists principally of Cantonese chickens, the majority of which originated from the improved Cantonese strain of the College of Agriculture, and the rest were from strains directly imported from Amoy, China. The stock during the last three years had never numbered less than one thousand, and after the hatching season, 1927-28, it totalled about three thousand fowls. It is estimated that the entire place is capable of maintaining about 5,000 layers, so that when the epidemic occurred, the farm was not over-stocked.

There were a few Silkie, Barred Plymouth Rock, and White Leghorn chickens in the place. A few Native pigeons were kept in an open pigeon house adjacent to the laying houses.

Symptoms of disease that broke out on the farm. There was loss of appetite, marked thirst, and dopiness. A thick tenacious mucous was discharged from the beak and nostrils; the nostrils were later plugged up with dried secretions. There was also marked conjunctivitis, the birds gasped for breath. There was a nervous twitching of the head. The comb and the rest of the head became purplish. The chickens assumed a sitting posture when signs of heavy breathing became more marked.

The temperature was above normal, 41.4°C. (106.7°F.), both morning and afternoon during the first three or four days. If the chickens did not die, the temperature dropped to 40.0°C. (104.0°F.) on the sixth or seventh day. The crop became distended with gas, and there was marked diarrhea with white fecal discharge. In spite of the purging the sick bird maintained its weight. The disease attacked the adult birds that

¹These notes were sent to me by Doctor Go Kee, a practicing physician in Manila and proprietor of the Baclaran Poultry Farm. They are here published for the benefit of other poultry raisers. Doctor Go Kee, a busy man in his profession, finds in his poultry business much diversion and usually fair profit. He avails himself of recent developments and discoveries in Poultry Husbandry. He has faith in the industry. The hard luck of the past months as given in these notes has in no way discouraged him. He is restocking his farm and hopes in two years to have his industry back on its January, 1928, basis, or better.

—F. M. FRONDA, of the Department of Animal Husbandry.

were at the height of their productive stage; the younger birds were less susceptible.

The course of the disease was two weeks. The few chickens that recovered without treatment have one of the legs paralyzed. This paralysis is unilateral, never bilateral. Even if the bird recovered, apparently, there remains a slight habitual twitching of the head.

Treatment tried. While the scourge was raging, we brought twenty cases, all Cantonese layers, to our clinic (205 Calle Soler, Manila) for observation and treatment.

These birds were fed with a mixture of native onions and green pepper three times a day. Quinine bisulfate powder, mixed with water, at the rate of two grains a bird, was given three times a day. The birds were given plenty of food and fresh water was open to them at all times.

Six of the chickens that were thus treated died in the course of three or four days, and fourteen of them recovered at the end of two weeks. Those that recovered, we still keep on the farm and they lay eggs, although the number is below normal. One hen is still kept (July) in a separate coop and is suffering from paralysis of one leg. She is able to feed herself, however, and is capable of laying on the average, two eggs a week.

Autopsy. The crop of the birds that died of this disease was filled with gas and mucous. The gastro-intestinal tract was usually empty, the serosa showing a white glistening appearance, and the mucosa characterized by petechial hemorrhage. The ovaries of the hens were filled with a creamy, caesous material, which on bacteriological examination was found to contain *Staphylococcus albus* and *aureus*. The heart and liver showed slight congestion with petechiae. The other organs of the body were apparently normal.

Transmission. The disease is transmitted by the water in the common drinking troughs becoming contaminated by the mucous discharge of a sick bird. Healthy chickens confined in separate coops and kept near the sick birds, but with separate drinking troughs did not contract the disease. We saw healthy birds picking and eating the feces of the sick birds and fearing that these might be contaminated they were isolated immediately and kept under observation. They did not contract the disease. Forty adult chickens that were thus isolated were saved.

Compared with the other breeds on the Baclaran Poultry Farm, the White Leghorn chickens were very susceptible to this particular disease. Then in order of susceptibility were the Barred Plymouth Rocks, Rhode Island Reds, and the Cantonese. After many birds had died, some of the sick chickens were placed with forty healthy ducks (White Pekingese) and fifteen Native pigeons, and two "rice birds", but there were no ill results.

How the Baclaran flock became infected. Here, we can only theorize. It is inconceivable that the disease can be carried any great distance, as the

virus dies out very quickly. The epidemic has been in the neighborhood of the farm for quite a long while, but not a sign was noticed in the flocks till about the middle of February, 1928. The farm is very well fenced, so that no animal of any kind can get in. Customers coming to buy poultry and eggs are not allowed in the poultry yards, hence the chances of infection coming through this source may be considered negligible. It was suspected that neighbors envious of the good health of the Baclaran fowls while their chickens were dying, might have thrown into the farm yard some of their dead chickens. Birds, as the barnyard sparrows, might also have introduced the disease. After the infection got in, it spread like a fire. Preventive measures could not be taken, the disease spread too rapidly.

EXTENSION DIVISION NOTES

*Prepared by Moises M. Kalaw under the supervision of Prof. I. Elayda,
Director of Extension Service*

The Tuyo (dried fish)

Persons who are used to having the common *tuyo* for their principal breakfast dish or as an appetizer for other meals, look for it wherever they happen to sojourn in the Philippines. Dried fish can be found in almost any town in the Philippines—sun-drying being the most common way in the Islands of preserving fish—but in places far from Manila the popular *tuyo* as made in Bataan and sold in the Manila markets and in provinces getting their supply from Manila is not often on sale. For example in several town markets in the Bicol region as well as in the Visayan Islands there is for sale plenty of what is called *tuyo* but it lacks decidedly the taste and the state of preservation of the Bataan *tuyo*. And yet the dried fish so lacking in taste exhibits practically the same characteristics as the species caught in the Manila Bay by Bataan fishermen and made into *tuyo*. Evidently the difference lies in the method of preparation.

For the benefit of those who may be interested in the adoption of the method used in Orion, Bataan, a translation of a simple recipe for making *tuyong tonsoy* is here given. This recipe written in Tagalog was secured by Gregorio S. Chan, a student in the College of Agriculture.

For one petroleum can of this kind of fish prepare a brine of three gantas (9 liters) of common salt. Or the proportion may be a *canastro* (a common dry measure basket) of fish and a brine made of one and a half cavan (25 gantas) of salt. In making the brine care should be taken to dissolve the salt thoroughly in water. Then the fish are immersed in the brine. To keep the fish from spoiling more salt is added on the top of the pile of fish in brine. If the fish are put in the brine in the evening, they should be washed in the morning with fresh water and spread out at once on a bamboo slat flat tray and put to dry in the sun. At noon time the dried fish are counted and turned over for further drying by placing an empty tray on top of the fish and inverting the first tray which is then removed. The drying process is continued in the afternoon as long as there is sunshine. In bright sunshine, it takes only one day to finish the drying; but sometimes it takes one day and a half, depending upon the degree of dryness of the salted fish. Once the fish are dry they are allowed to cool off on the tray, then are packed up in baskets (*canastro*), ready for the market.

There are two kinds of this Bataan *tuyo*, *tuyong tonsoy* and *tuyong lapad*. They are treated alike in the process of preservation; but the fish

used in making *tonsoy* is larger, more meaty, fatter and more tasty than that used in making *lapad*, and sells at a higher price. But the keeping quality of the *lapad* is better because it has less fat than the *tonsoy*.

More College Copra Drier Enthusiasts

In previous issues of this Journal mention has been made in these notes of the continued requests for information about the College Copra Drier. Mention has been made also of several driers of the College type having been built in nearby provinces. Recently requests from three plantation owners for a College representative to direct the construction of driers of the College type were received. The first was from Mrs. Caselda de Mejia of Ormoc, Leyte, the second from M. L. Liddell of the Sumagui Lumber Company of Pinamalayan, Mindoro, and the third from Mr. Espiridion Villegas of Vallehermoso, Oriental Negros. These requests are accompanied by offer to pay all the travelling expenses of the College representative from the College to the places and return.

The first request was favorably considered. The College extension representative is waiting for communication from Mrs. Mejia as to whether all the materials are ready in accordance with the list furnished her. The other requests can be complied with only after the work in Leyte is finished as there is no available man in the Extension Division to send.

It should be mentioned in connection with the first request that the man responsible for the arrangements with Mrs. Mejia is Mr. Mauro Rodriguez, Extension Agent of the Bureau of Agriculture stationed at Leyte. If the College drier should become popular in Leyte as a result of its introduction in Mrs. Mejia's hacienda credit will be due Mr. Rodriguez.

Relative Importance of Extension Service in a College of Agriculture

There is no State College of Agriculture in the whole United States that does not maintain with adequate support a strong Extension Department with its own Director and a personnel and activities much larger in scope than any other department of the institution. Its rôle and function are considered essential to the College of Agriculture in its function of serving the interests of the farmers. It is through its agency that the College learns the real needs of the farmers and humanizes and puts into practical and productive use the results of its investigation and research underlying its program of instruction, by direct and helpful contact with the farming public. The relative importance of Extension service is depicted in the following list of activities for which the land Grant Colleges Dollar was spent in 1925-26:

Resident Instruction.....	35 cents
Physical Extension.....	13 "
Extension Service.....	12 "
Research.....	8 "

Operation and maintenance of plant.....	8	"
Supplementary operation.....	6	"
Administration.....	6	"
Dining Halls.....	3	"
Trust Funds.....	3	"
Hospital.....	2	"
General Library.....	2	"
Dormitories.....	1	"

These figures are from a Survey of Land Grant Colleges by Walter J. Greenleaf, Assistant Specialist in land grant college statistics, 1927.

The father of Extension Service of America, Professor Knapp, once stated in the early days of the American Extension Service that sooner or later every modern civilized country was bound to establish and maintain an extension service for the country.

Referring to the county-agent service in America back in 1916 (1916 Year Book of the United States Department of Agriculture) Mr. Carl Vrooman, Assistant Secretary of Agriculture, said:

This county-agent movement is the greatest and most practical university extension movement ever inaugurated in any country. It is essentially nothing but learning democratized, learning brought out of the laboratory and the experimental field, out of the libraries and the bulletins, adapted to local conditions, and brought home to the farmer by the power of personal explanation and of actual demonstration.

In our opinion there is no country on earth no matter how backward in civilization that is not ready and amenable to receive and benefit by the Extension Service as long as the methods used are adapted to local conditions. Personally it was observed that even in modern civilized countries, the first attempt at Extension Service was not received with much favor and enthusiasm by the farming public. But the attempt continued with more and more vigor, until the time came that the same public came of its own accord to recognize the indispensability of Extension Service for the rapid amelioration of rural communities and farming conditions.

EXCHANGE NOTES

Probably the most interesting of the dairy landmarks kept at the Wisconsin institution is the first Babcock test, a device invented by S. M. Babcock, who is still living in Madison, and even at the age of 84 is often found busying himself in his laboratory. The original testing machine is, as would be expected, a large, cumbersome contrivance alongside of the present, attractive models. No change, however, has been made in the principle by which it operates since Dr. Babcock perfected in in the late eighties.

On the campus of the Wisconsin institution stands the first school in which special dairy courses were given in the country. This was established in 1890, as an outgrowth of the perfection of the Babcock test.

—*Butter and Cheese Journal*.

On many farms plans are now being made to sow substitute or emergency hay crops. "The soybean is the best hay substitute for dairymen when there are shortages of clover and alfalfa," declares a farmer. "It contains as much, if not more, protein than alfalfa and if harvested with care its palatability is unquestioned."

—*The Prairie Farmer* (Illinois).

What might be called an insect zoo has just opened in Paris where the public is turning its attention from the lions and tigers in the menageries to see the new vivarium in the Jardin des Plantes. Here it has the extraordinary experience of watching insects in their natural environments, each group shown in an indoor glass cage fitted up to seem like home to the inhabitants.

This somewhat unique accomplishment has not been so easy as it might seem. The insects come from various climates and their requirements are naturally vastly different. Thus a complicated heating system is necessary to simulate the African desert in one cage and a coolish temperature in the next. Heat, humidity and light have all formed tremendous problems solved by the ingenuity of Dr. Jeannel, director of the vivarium.

In some cases it has been necessary to fool the insects for the benefit of the public. In their desire to establish the closest possible contact with objects about them, the scorpions, if left to their own devices would completely disappear from sight by burying themselves and leave the public to look at a seemingly empty cage. However, they seem very well satisfied to hide beneath plates of transparent glass through which they can easily be seen.

—*Science*.

The Name *Gur*, we are told in the Supplement to the *Indian Trade Journal* of March 1, on "Gur and its Prices in India," by Ksanji D. Naik, M. A., of the Sugar Bureau at Pusa comes from *guda* or *gula*, indicating a thickened ball or mass, and hence thickened sap or the modern *gu*, or raw sugar. *Jaggery* is a corruption of *sarkara*, via the Malaya word *chakkara* and the Portuguese *Jagara* or *Jagra*. *Gur* when clean is a perfectly wholesome food; it is, in fact, preferred even to sugar at times. Its delicious aroma and greater sweetness appeal to many palates. It has also been stated that it is rich in vitamin B, which white sugar lacks. Fine golden-yellow coloured *gur* generally fetches the highest price. When the cane

juice is left semi-liquid, that is half-way to *gur*, it is known as *rab*, and in that state is purchased by others to be refined.

—*Tropical Life*.

Margaret R. Pool, a sophomore in home economics, won the silver trophy awarded to the fastest co-ed milker by the little International Livestock Show held recently at Ohio State University.—*Agricultural Student*.

—*The Iowa Agriculturist* (Iowa State College).

The importation into the Union of South Africa is prohibited of bone meal or other bone fertilizers or farm foods (except dissolved bone) or any fertilizer or farm food containing meat meal, blood meal, or any product derived from any animal carcass, unless accompanied by a sworn declaration from the manufacturer that it has been effectively sterilized and that the sterilizing plant has been inspected by a competent government official.

—*Commerce Reports* (U.S.A.).

Weight for weight, dried prunes supply more body fuel than dried apples, milk, roast beef, eggs or bread. This is chiefly on account of the high carbohydrate content, and I do not mean to say that prunes are a better diet than, say milk, for many other factors such as protein balance or ratio, digestibility, &c., must be taken into account. However, prunes are a highly nutritious food, and in addition they are laxative. Why not buy prunes instead of pills; the old saying, "An apple a day keeps the doctor away," might have added to it "Six prunes a night will starve him outright".

—W. M. JOSEPHSON at *Murrumburran Bureau of Conference*.

—*Agricultural Gazette* (N. S. W.)

COLLEGE AND ALUMNI NOTES

Major A. Parker Hitchens, medical adviser to the Governor General and lecturer in the School of Sanitation and Public Health, addressed the Student Body at Convocation in July. Major Hitchens spoke on the diseases prevailing in the Philippines that are most detrimental to economic progress. As listed by the speaker, these are: tuberculosis, beri-beri, intestinal diseases, leprosy, and malaria. How these diseases retard progress and how they can be controlled and eradicated were simply and forcefully presented by Major Hitchens.

Dr. Walter Williams, Dean of the School of Journalism in University of Missouri, accompanied by Mrs. Williams and Mr. Roy C. Bennett, Editor of *Manila Daily Bulletin*, were Campus visitors in July, guests of

Professor Yule. The School of Journalism of which Doctor Williams is dean and founder is the oldest in the world.

Miss Alice E. Thuman reported for duty as instructor in English on July 26. Miss Thuman is a graduate from University of Nebraska. She came to the Philippines via Europe.

Mr. E. J. de Boer, of Seattle, Washington, brought in a shipment of 26 head of Holstein cattle on July 13. This is the first important importation of this breed of dairy cows in the Philippines. The Department of Animal Husbandry acquired two cows paying one thousand pesos a head. The average yield of milk per cow a day has been 16 to 17 liters.

The following letter to Professor Yule from Mr. Dimas Maulit who completed his work for graduation in May, is a tribute to the late Dean Baker, so spontaneous, so sincere that we share it with our readers:

I am sending you herewith as my humble contribution to the Baker Memorial Fund a postal money order for five pesos (P5.00). Please accept it as a token of my reverence for the memory of our beloved dean. I cannot forget him. He loved his students and was most generous to them. He sincerely believed in them and such a great faith in them as he always showed encouraged and inspired them with manly self-confidence in their struggle for the realization of their ambitions. No wonder he has been called the inspirer of youth and maker of men.

Mr. Maulit is teaching in Central Agricultural School at Muñoz.

Mr. Francisco Sacay, B.S. '27, now a U. P. Fellow studying in Cornell University in a letter to Professor Yule, inclosing a contribution to the Baker Memorial Fund, writes briefly of his trip across the Pacific and the United States, but more fully on his need of all the training and teaching he had received in English. Mr. Sacay registered for every English course given in this College making a record of 1 in English 6 and 11.

The papers read and discussed at the meeting of the Los Baños Biological Club on June 20 were:

"Agricultural problems in the island of Hermano Mayor"

by Dr. R. B. Espino

"Observations in Bukidnon" by Dean Gregorio San Agustin.

At the meeting held on July 16 the papers presented were:

"Some observations on agricultural research in Japan"

by Dr. R. L. Pendleton.

"The Imperial Government Institute for Nutrition, Japan."

by Dr. F. O. Santos.

The Mimics with Miss Cole as Director began work in August. The Department of English under which the club functions made some changes in the organization this year. Members are limited to students in the College of Agriculture of collegiate classification. There are weekly meetings of one hour devoted to study of the technique of the drama and its presentation. Attendance and work of members are recorded as in regular college work. "Daughters for Sale" will be the first play presented.

The twenty-eight women students in College this year are organized as "The Associated Women Students of the College of Agriculture." Miss Anderson of the Department of English under whose supervision the organization was completed is the official Adviser.

The most important features of the first monthly meeting of the Self-Made Man Association," a student organization of the College of Agriculture on August 2, 1928, were: (1) the general revival of the spirit of co-operation among the members present; (2) the creation of a new committee to look after the safety of the interests of the Association; (3) the formulation of feasible plans to campaign for more members and to raise some more money so as to "swell" its fund and thereby live up to its principles of helping the many poor needy student members; (4) the report of the Treasurer through the out-going president, F. N. Camba; and (5) the election which was followed by the installation of the elected officers who are as follows:

<i>President</i>	Paulino M. Ungos
<i>Vice-Pres</i>	Felix A. Padlan
<i>Secretary</i>	Procopio G. Giralao
<i>Treasurer</i>	Felix N. Camba
<i>Adviser</i>	Prof. M. B. Raymundo

On Aug. 3, 1928, a snappy musical-literary program was held in the Auditorium of the College of Agriculture under the auspices of the Military Department. Some of the special features of the program were the "Leaf" selection by Cadet Pvt. Lorenzo Talatala; the "Classical African Trot" by Cadet Pvt. Honorio Reyes; the address by Major Gilmore; and the award of medals and badges to cadets and sponsors by Mrs. R. A. Gilmore. The program closed with the "Third Batallion March" by the audience.

The promotor of the program was the Anta-Luns, an organized body of cadet officers of the College of Agriculture who deserve commendation for putting on a very lively program which for the time broke the monotony of the students' daily grind on the campus.

During the town fiesta at Magdalena, Laguna, on July 22, 1928, the U. P. Los Baños basketball team in a game with the Laguna High School

team, won with a score of 32-8; the Magdalenaians, with a score of 28-10. The College winning team was awarded a silver cup donated by the Magdalena Elementary School teachers.

The Fourth Annual Intramural Athletic League of the Los Baños Colleges was formally opened on July 31, 1928, by Dr. Gregorio San Agustin, this year's chairman of the Los Baños Committee of Athletic Management. Chairman San Agustin tossed the first ball. There are seven units competing for the championship events in the League: namely: (1) C. A. Seniors ('29); (2) C. A. Juniors ('30); (3) C. A. Sophomores ('31); (4) C. A. Freshmen ('32); (5) C. A. Supplementary-Preparatory-Special; (6) Veterinary; and, (7) Forestry. Strong competition is again expected this year with Alkan, Inc., once more offering valuable prizes to the winners of each of the following events: (1) Basket ball; (2) Volley ball; (3) Soccer Football; (4) Relay Carnival; and, (5) Track and Field.

Dr. S. A. Francisco, College Physician, is now giving one-hour weekly lectures on Personal Hygiene to the freshmen of the College of Agriculture. This is a Physical Education requirement of all first year Collegiate students in the University.

Both the Los Baños Faculty Sporting Club and the Los Baños Colleges Sporting Club held tennis singles handicap tournaments during May and June, 1928. In the former, Ramon P. Tolentino, Jr., of the Department of Physical Education came out triumphant and won the silver loving cup donated by Brias Roxas, Inc. In the latter, Roberto R. Moreno and Francisco Barros, both of the Chemistry Department, were awarded the tennis rackets offered by the Athletic Supply Co. to the winners in the Class A and Class B Groups, respectively.

On June 9, 1928, the first dual tennis meet between the Manila and Los Baños faculty members was held on the Los Baños Faculty Sporting Club courts. The Manilans won six of the nine matches played and thereby captured the Brias Roxas cup. Those who represented the U. P. Manila faculty were Lieutenant Guevara, Doctors Alvir, Vasquez, Mandanas, Velarde, Tan, Quiason and Gokhale; Professors Manguerra, Virata and Zafra, and Mr. Jison. The Los Baños line-up was composed of Doctors San Agustin, Francisco, Mendiola, Lava, Espino, Tubangui, Gordon, Mondoñedo, and Adriano; Professor Sulit, Lieutenant Martelino, and Messrs. Tolentino and Mabakiao.

A return encounter between these two teams in Manila is scheduled for August 11 on the Philippine Columbian Association tennis courts. A close competition is anticipated.

VOCATIONAL TEACHERS OF AGRICULTURE IN NORTH CAROLINA

The opening paragraphs of an article "Teachers of Agriculture in North Carolina" by J. B. Britt, Chancellor of the University of N. C. published in *Quarterly of Alpha Zeta*, April, 1928, states so succinctly the opportunities of agricultural teachers that we reprint them. As to what an agricultural teacher may do Chancellor Britt might have been writing of the Philippines instead of North Carolina, so well does he visualize the field.

In the South agriculture has made progress that has been slow but surely a growth that is phenomenal within the last twenty years.

Trained agricultural leadership has been largely responsible for this growth. It has taken time and energy to establish leadership that was sound, scientific, and presented in a way that the farmers of the South would follow.

This achievement has been such that the workers should feel a just pride in their accomplishment.

Great progress has been made, especially in the field of vocational agriculture. A form of leadership in which the highly trained specialist gives to the high school boy a training that is both thorough and practical. The student receives both the theory and demonstrated practice of scientific agriculture. In the vocational agriculture scheme of instruction, not only does the son of the farmer receive training, but the father of the high school boy receives instruction in evening classes on the approved methods of doing things. Thus it is not necessary to wait for a new generation to grow to maturity for a better method of farming to be installed. Rather the result is immediate and effective.

Up to the present time the demand for vocational agriculture teachers has been greater than the supply. The southern farmer is realizing more and more the value and place of the agricultural teacher in the high school.

Not only does the vocational teacher give instruction to his class but he also becomes a community leader, an organizer of community fairs, cooperative organizations for the general upbuilding and betterment in the community. Interest in good roads, young people's organizations, are found to be popular by-products of the agricultural teacher's work.

It is true the agricultural teacher's job is primarily that of instructing in the class room. His leadership does not stop there for he occupies an unique place in the community by being in the position to assume leadership in building a rural life in which there is progress in every respect.

It is exceedingly gratifying to those in charge of vocational work in the South and those concerned about the rural welfare and development to know that the great majority of agricultural teachers are contributing to the growth of a better agricultural condition. Besides class room and evening class instruction it has been found by careful records that the teachers have contributed to rural welfare by assisting in the annual rally of the school, assisting farmers in purchasing fertilizer and pure bred live stock; serving as chairmen of an agricultural committee; promoting strawberry and watermelon associations; conducting a community crop project to produce funds to help pay for the maintenance of the vocational agricultural work; conducting motion picture shows on Saturday nights; holding picnics; conducting young men's Sunday School classes and Bible classes; acting as president of the county teachers' association; superintending county fairs; producing cabbage plants and other seedlings for the patrons of the school; assisting the farmers in the marketing of their products; surveying the counties and the communities in which they reside in order to obtain information to place before advisory committees; conducting educational tours of the farmers to the state agricultural college, assisting the Chamber of Commerce in a close cooperation between farmers and rural pupils and many other activities of like nature.

One immediately says that to do all this requires scientific training, energy, initiation, and tact. This is true. But the utilization of these four factors has been responsible in a large measure for the progress of the Southern states in the agricultural field.

It is impossible to estimate the financial value of the services of the agricultural teachers to their communities. It is estimated that some of the teachers increase the earning of the farmers that they work with approximately \$500 per farmer. These increases are obtained by the use of better seeds, a saving in time and in quality of fertilizer purchased, and cooperation in selling the produce.

Who can measure the money value of a cooperatively working community in which there is pride shown in the quality of crops grown, the quality of live stock produced, pride in school and church work, in fact an entire community working harmoniously for rural welfare and progress? This is the job that the agricultural teacher has set himself to do.

The Alternative—Research or Retrogression.

—*Forbes Magazine.*

A REPORT ON THE ASEXUAL INHERITANCE OF "MANY-EYED" CHARACTER OF SUGAR CANE¹

TORIBIO MERCADO
Of the Department of Agronomy

WITH TWO TEXT FIGURES

INTRODUCTION

One of the many characters which the plant breeder desires to improve in the sugar cane plant is the percentage of "germination" of the eyes. A good germination means less expense and lower cost of production than a poor germination. The ability of a cane to germinate well depends, among other things, on the number and vigor of the eyes at each node. Usually there is only one such eye. Unquestionably, a node containing more than one eye will have a higher germinating ability than one with only a single eye. Occasionally stalks are encountered possessing more than one eye at each node.

Observed cases of bud variations on sugar cane with reference to the eye

Variations of sugar cane stalks with respect to the presence or absence of eyes, irregular occurrence of single and double eyes in a stalk, and branching of stalks have been observed. A description of these reported abnormalities follows:

A stalk with short joints. A stalk with very short joints, each node having two eyes diametrically opposite, was observed on Yellow Jamaica variety by F. Serban in Lima, Peru.²

A stalk with eyes on each node at right angles. A stalk with two eyes in each joint, the eyes alternating at right angles at every other joint was found in the island of Kauai by Mr. Geo. H. Fairchild (1926) and mentioned in one of his letters to Dr. N. B. Mendiola of this College.

Eyeless nodes. When the Plant Breeding Division of this College raised its batch of sugar cane seedlings in 1922-1923, a stool was found with all its nodes eyeless. It consisted of five stalks. Good care was given to the plant, but later on it died. Figure 1 (*d*) gives an example of this character.

Branching. Branching was first observed by the writer in the cultures of the Pampanga Sugar Mills while working in that place from December,

¹ Experiment Station contribution No. 551. Prepared in the Department of Agronomy under the direction of Dr. N. B. Mendiola. Report read before the Los Baños Biological Club, September 6, 1928. Received for publication September 7, 1928.

² The Planter and Sugar Manufacturer, March 6, 1909.

1926, to February, 1927. A similar case was reported by Labrador (1927)³ of the Bureau of Agriculture in La Carlota Experiment Station, Occidental Negros. An example of this case is shown in figure 1 (a).

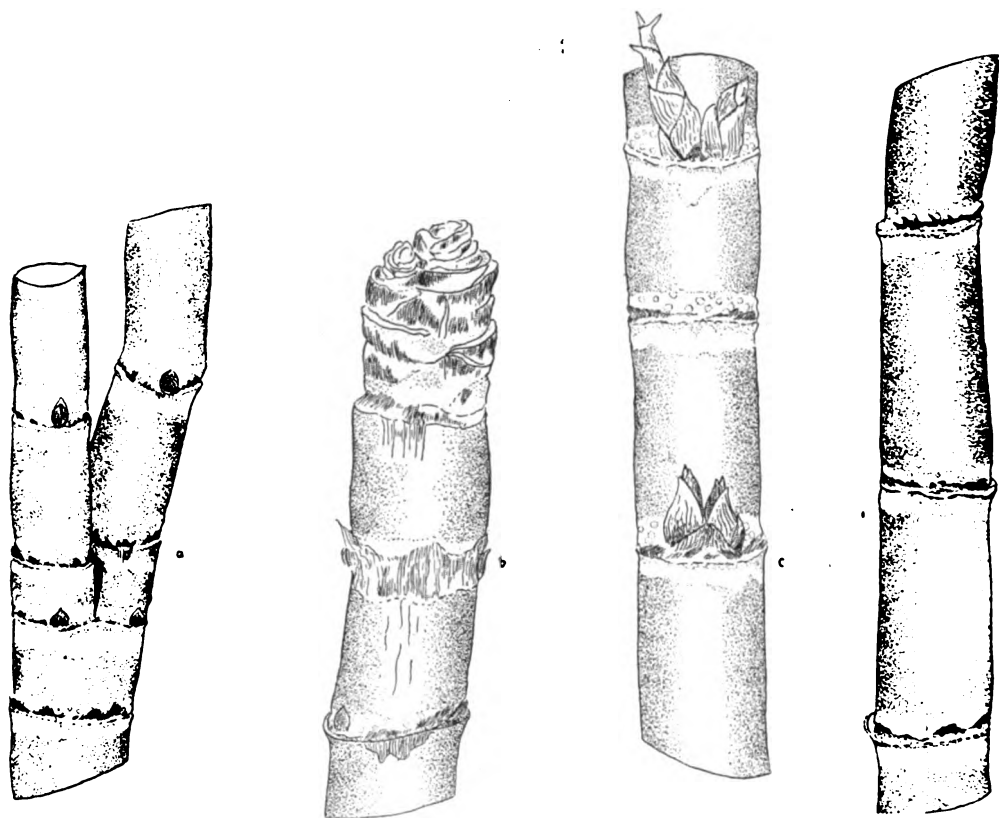


Figure 1.—Observed cases of bud variations on sugar cane with reference to the eye. *a*.—Branching stalk; *b*.—Portion of stalk with multiple buds on top; *c*.—Portion of a stalk with double eyes in a node; *d*.—Eyeless stalk.

Double eyes. Another interesting abnormality found among sugar canes was a stalk with a row of double eyes at one side and a row of single eyes at the other, formed throughout the entire stalk. It was observed in a stool of P. B. 117, one of the seedling canes raised in this College. (See figure 1 (c)).

Multiple eyes. More than five eyes in a node were found at the upper end of a stalk of Mauritius Malagache variety. It was observed among the ratoon canes at the beginning of the wet season in May, 1927. (See figure 1 (b)).

³Labrador, A. 1927. A case of teratological twinning in sugar cane. The Philippine Agricultural Review: 20: 2: 289.

Top of flowering stalks found eyeless. It was observed that at the end of a flowering stalk several nodes did not produce eyes. Below the eyeless nodes, joints with one eye each were found.

Object of the present work

The object of the work here reported was to find the degree of asexual inheritance of "Many-eyed" character of a cane stalk.

Time and place of the work

The work was conducted in the College of Agriculture Plant Breeding Garden from June, 1927, to March, 1928, covering a period of ten months. This report includes one asexual generation of the cane studied.

MATERIALS

Description of the mother cane plant used

This cane is a seedling cane of Badila parentage. It is a purple cane, with medium sized stalks, semi-erect, with fair tillering habits, and cracks sparsely. The internodes are medium in length, normal in shape, with a thick glaucous band, and large and prominent eyes, one or more of them being at each node. A study of the "Jeswiet hair groups" of one pair of these eyes showed that they have identical hair groups.

Methods of observation

It was in June, 1927, that the material used in this study was found among the naturally selfed Badila seedling cane varieties raised during the 1925-1926 season. The four stalks which constituted the plant were taken to the laboratory for study. Each node in each stalk was numbered consecutively from the top of the stalk downward. The eyes found in each node were counted. They were planted in seed boxes and the shoots that developed were noted and transplanted in the Plant Breeding Garden. During the growing period of the plants, they were given similar treatment as to cultivation and fertilization. Ammonium sulfate was applied to the planting once.

Germination test

The field germinating ability of the cane variety was compared with that of Luzon White, one of the commercial native varieties in Los Baños. All available points, excluding body cuttings, were used in this study. Two points were taken from each stalk. All the points from one stool were planted separately from the points of the other. Two hills were used as check for each group of cuttings from one original stool. Two points of Luzon White were planted in each hill while one cutting of the "Many-eyed" variety was used to a hill. Before planting, all the points were treated in the same way. They were soaked in water for forty-eight hours and

were kept in the germinating shed for a week. Five weeks after planting the percentage of germination was taken.

RESULTS

The results of this work are given in tables 1 to 6.

Table 1 gives the number and percentage of nodes with one, two, and three visible eyes, found in each original parent stalk.

Table 2 gives the percentage of germination of the single, double, and triple eyes separately. The percentage is found by dividing the number of shoots produced by the number of nodes and the quotient multiplied by one hundred.

In table 3 is found the total production of single, double, and triple eyes, separately.

Table 4 presents the percentage of single and multiple eyes, both in the parent and offspring.

Table 5 gives the comparative germination test of "Many-eyed" variety versus Luzon White.

Table 6 presents the hair groups of the twin eyes.

DISCUSSION OF RESULTS

Percentage of one, two, and three visible eyes in each stalk

It will be seen in table 1 that the percentage of nodes with one visible eye in the node of the four original stalks studied ranged from 53.33 to 68.1, giving an average of 60.52. The percentage of the nodes with two visible eyes each varied considerably from 9.09 to 33.33, the average being 26.43. The nodes with three visible eyes each were few in number as compared with those of one or two eyes each. It ranged from 6.06 to 22.7 per cent. It is of interest to note the ratio of the single, double, and triple eyes. The first stalk gave a ratio of 2:1:1/5 or 10:5:1; the second stalk, 2:1:1/3 or 6:3:1; the third stalk, 7:1:2; and the fourth stalk, 2:1:1/2 or 4:2:1. Of the 114 original nodes studied, 69 nodes had one single visible eye, 30 had double visible eyes, and 15 had three visible eyes, giving a total ratio of 2:1:1/2 or 4:2:1.

TABLE 1

Percentage of one, two, and three visible eyes in each parent stalk

STALK NO.	NUMBER OF NODES STUDIED	NODES WITH ONE VISIBLE EYE		NODES WITH TWO VISIBLE EYES		NODES WITH THREE VISIBLE EYES	
		number	per cent	number	per cent	number	per cent
I	33	20	60.60	11	33.33	2	6.06
II	29	18	62.00	8	27.56	3	10.34
III	22	15	68.10	2	9.09	5	22.70
IV	30	16	53.33	9	30.00	5	16.60
Total	114	69	60.52	30	26.43	15	13.15

Germination under nursery conditions

In table 2 it may be seen that the percentage of germination of nodes containing the three visible eyes is much higher than that of the nodes with two visible eyes, and very much higher than that of the nodes with a single eye each. Some of the nodes gave over 100 per cent germination. This difference may be explained by the fact that in most cases some invisible eyes developed into shoots. Stalk I gave 70.0 per cent of germination of nodes with single eye each, 145.45 per cent with double eyes, and 200 per cent with triple eyes. Stalk II gave 88.89 per cent of germination of nodes with single eye, 162.5 per cent with double eyes, and 200 per cent with three visible eyes. Stalk III gave 100 per cent germination of nodes with single eyes, 200 per cent with double, and 260 per cent with triple. Stalk IV gave 106.25 per cent of nodes with single eye, 155.56 per cent with double, and 100 per cent with triple. Of the four stalks studied, there was an average of 91.29 per cent of germination of nodes with single eyes, 165.88 per cent with double, and 190 per cent with triple, grown under nursery conditions.

TABLE 2
Percentage of germination

STALK NO.	NODES WITH ONE VISIBLE EYE			NODES WITH TWO VISIBLE EYES			NODES WITH THREE VISIBLE EYES		
	Number	Shoots found	Percentage of germination*	Number	Shoots found	Percentage of germination	Number	Shoots found	Percentage of germination
I	20	14	70.00	11	16	145.45	2	4	200
II	18	16	88.89	8	13	162.50	3	6	200
III	15	15	100.00	2	4	200.00	5	13	260
IV	16	17	106.25	9	14	155.56	3	3	100
Average			91.29			165.88			190

Hereditary behavior of single and multiple eyes

In table 3 may be seen the hereditary behavior of the character under study with reference to single and multiple eyes. It is evident that single or double eye characters are not always asexually inherited. The occurrence of the multiple eyes is inherited from the parent in nodes with one visible eye each as well as in nodes with double or triple eyes. As shown in the upper section of table 3 the nodes with a single eye each produced true to their original character, yielding 85.57 per cent, but produced 13.52 per cent with two visible eyes, and 0.90 per cent with three visible eyes. The nodes with two visible eyes yielded fewer nodes with a single eye than parent nodes with only one eye each, but more nodes contained double and triple eyes. This is shown in the middle section of the same table. Of the 390 nodes, 81.03 per cent were with single visible eye, 17.95 per cent with double visible eyes, and 1.025 per cent with three visible eyes. The third section of the same table shows that there was a production of 80.04

per cent of single eyes from nodes with three visible eyes, 18.82 per cent with double eyes, and 1.33 per cent with triple eyes. However, the production of nodes with double or triple eyes was much higher than that of the nodes from single or double eyes.

TABLE 3
*Production of multiple eyes
From nodes with only one visible eye to the node*

ORI- GINAL STALK NO.	NODES STUDIED	NODES WITH ONE VISIBLE EYE		NODES WITH TWO VISIBLE EYES		NODES WITH THREE VISIBLE EYES	
		number	per cent	number	per cent	number	per cent
I	499	452	90.58	43	8.61	4	0.80
II	477	424	88.88	48	10.06	5	1.04
III	403	313	77.66	86	21.34	4	0.99
IV	174	140	80.46	33	18.96	1	0.57
Total	1553	1329	85.57	210	13.52	14	0.90
<i>From nodes with two visible eyes to the node</i>							
I	46	37	80.43	8	17.39	1	2.17
II	119	105	88.23	13	10.92	1	0.84
III	113	98	86.72	13	11.504	2	1.77
IV	112	76	67.85	36	32.14	—	—
Total	390	316	81.03	70	17.95	4	1.025
<i>From nodes with three visible eyes to the node</i>							
I	63	57	90.47	6	9.52	—	—
II	97	85	87.63	12	12.37	—	—
III	265	199	75.09	61	23.02	5	1.89
IV	16	12	75.00	4	25.00	—	—
Total	441	353	80.04	83	18.82	5	1.13

Comparing the hereditary production of single and multiple eyes by the four original stalks it may be noticed that in general there was an increase in the number of nodes with one visible eye, and very marked decrease in multiple eyes. This is shown in table 4. Stalk I with 60.60 per cent of nodes with single eye, 33.33 per cent with double eyes, and 6.06 per cent with three visible eyes had in the next asexual generation 89.8 per cent nodes with single eye, 9.3 per cent with double eyes, and 0.82 per cent with triple eyes. The progeny of stalks II and IV also showed an increase in single eyes, and decrease in double and triple eyes. The offspring of stalk III had a similar increase in yield of nodes with single eye, but yielded more nodes with double visible eyes. It also gave a relative decrease of nodes with triple eyes. The parent nodes with 71 per cent single visible eye gave in the following generation 83.00 per cent nodes with one eye; the parent nodes with 25.02 per cent single eye gave 16.14 per cent of nodes with two eyes; and the 13.97 per cent nodes with single eye gave 0.84 per cent nodes with two eyes.

TABLE 4
Comparative production of multiple eyes

STALK NO.	NODES WITH ONE VISIBLE EYE		NODES WITH TWO VISIBLE EYES		NODES WITH THREE VISIBLE EYES	
	Parent	Offspring	Parent	Offspring	Parent	Offspring
	<i>per cent</i>	<i>per cent</i>	<i>per cent</i>	<i>per cent</i>	<i>per cent</i>	<i>per cent</i>
I	60.60	89.8	33.33	9.3	6.06	0.82
II	62.00	88.6	27.66	10.53	10.53	0.86
III	68.10	78.1	9.09	20.48	22.70	1.40
IV	53.30	75.48	30.00	24.24	16.60	0.27
Average	61.00	83.00	25.02	16.14	13.97	0.84

Field germination test of "Many-eyed" variety versus Luzon White

While the points of the two varieties compared were in the nursery, it was observed that the "Many-eyed" variety germinated earlier than the Luzon White. This may be explained by the fact that the "Many-eyed" variety has more and larger eyes than the Luzon White. The points of Luzon White started to germinate two days later than those of the "Many-eyed". Under field conditions the "Many-eyed" variety germinated well.

As shown in table 5 the "Many-eyed" variety gave a higher percentage of germination than Luzon White in spite of the fact that two points of Luzon White were planted in a hill, while only one point of "Many-eyed" was used. Stalk I with 120 points gave a field germination of 86.66 per cent, while the check representing Luzon White had only 77.5 per cent. Stalk II with 141 cuttings had 69.60 per cent of germination and the check only 54.12 per cent. Stalk III of 160 points gave 91.25 per cent germination and the check with 28 points had only 78.57 per cent. The check of stalk IV with a germination of 100 per cent had only 77.27 per cent. Luzon White gave an average germination of 71.87 per cent, while the "Many-eyed" variety had 86.88 per cent. These data clearly show that the "Many-eyed" germinated better than the Luzon White variety.

TABLE 5
Comparative germination test of the "Many-eyed" and Luzon White variety of sugar cane

ORIGINAL STALK NO.	NUMBER OF HILLS PLANTED	NUMBER OF HILLS GER- MINATED	PERCENTAGE OF GERMINATION
Stalk I.....	120	104	86.66
Luzon White (check) ^a	40	31	77.50
Stalk II.....	141	88	69.60
Luzon White (check).....	24	13	54.12
Stalk III.....	160	146	91.25
Luzon White (check).....	28	22	78.57
Stalk IV.....	15	15	100.00
Luzon White (check).....	44	34	77.27
Average germination of "Many-eyed" variety.....			86.88
Average germination of Luzon White.....			71.87

^aFor check using Luzon White two points were planted in each hill.

Jeswiet study of hair groups of twin eyes

As shown in table 6 hair groups, numbers 1, 2, 3, 6, 12, and 17 are found in most of the bracts of the twin eyes studied except group number 17 which is absent in bract number 4. There are, however, numbers 4, 5, 15, and 16 which are found in different bracts. It may be noted that upon dissection of the twin eyes a small eye was also found. The hair groups were so minute that few of them were drawn. Group numbers 1, 2, 3, 6, and 12 are found in this small eye.

TABLE 6

Hair groups found in twin eyes of "Many-eyed" variety

BRACT NO. 1		BRACT NO. 2		BRACT NO. 3		BRACT NO. 4		BRACT NO. 5		BRACT NO. 6		
Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Middle	Right
1	1	1	1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3	3	—	3	—
4	—	—	—	—	—	—	—	—	4	4	—	—
—	—	—	—	5	5	—	—	—	—	—	—	—
6	6	6	6	6	6	6	6	6	6	6	6	6
12	12	12	12	12	12	12	12	12	12	12	12	12
15	—	—	—	—	—	—	—	—	—	—	—	—
16	—	—	—	—	—	—	—	16	16	16	—	16
17	17	17	17	17	17	—	—	17	17	17	—	17

SUMMARY AND CONCLUSIONS

1. In this "Many-eyed" seedling cane variety double or multiple eyes were found in different nodes of the stalks. This is shown in figure 2. The visible eyes in the nodes did not necessarily mean the actual number of eyes present in the nodes. Sometimes there were small eyes hidden near the visible eyes.

2. In the same variety the percentage of germination of nodes with multiple eyes was considerably higher than that of the nodes with one eye each. The field test of this particular cane gave a relatively high percentage of germination. Under nursery and field conditions the "Many-eyed" variety germinated earlier than Luzon White. The "Many-eyed" with only one point to the hill gave a germination of 86.88 per cent, while Luzon White with two points in a hill gave only 71.87.

3. In this cane a parent node with one single bud did not produce only the single eye characteristic; it also produced multiple buds. Similarly, nodes with multiple eyes produced single, double, and triple eyes as well.

The parent plant had a ratio of 4 : 2 : 1 of single, double, and triple eyes, respectively. In the following generation there was found a ratio of 5.04 : 1.00 : 0.06 or 504 : 100 : 6 of single, double, and triple eyes, respectively.

4. In the first asexual generation there was an increase in the production of single eyes but a decrease of nodes with multiple eyes.

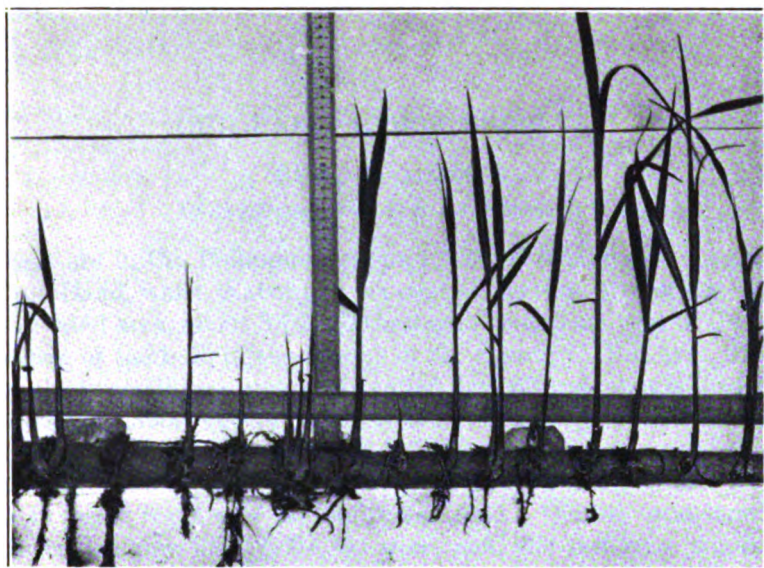


Fig. 2.—A stalk of "Many-eyed" variety of sugar cane showing the number of shoots produced by the different nodes.

5. Should the increase in the percentage of single eye continue in the following generations, the cane should become ultimately a one-eyed variety. On the other hand, should this variety continue to produce multiple eyes in the succeeding generations, its germination would be faster and greater than the Luzon White.

6. Twin eyes in a node of this variety have usually similar hair groupings, varying only in very few cases.

OUR FARM LABOR SUPPLY¹

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There are in the Philippines about 5,000,000 hectares of uncultivated agricultural land, which is about 19 per cent of the total area of the country. The cultivated area, about 3,703,700 hectares, or 12.5 per cent of the whole, is the source of the bulk of the income of the country. But even with this comparatively small area under cultivation agricultural labor is inadequate. The Bureau of Labor reports that in 1925 out of 2,857,401 laborers engaged in all the industries in the country, 2,547,572, or 89.15 per cent of the total were agricultural laborers. This number gives an average of less than one laborer to every hectare of the cultivated land. Of this total number of agricultural laborers only 1,594,360 were men, the rest were women and boys and girls.

TABLE 1

Showing the total wage earners in the Philippine Islands classified as males, females, and minors, by occupational groups^a

OCCUPATION GROUP	TOTAL	WAGE EARNERS		
		Male	Female	Minors
Agricultural.....	2,547,572	1,299,154	607,176	641,242
Fishing industry.....	50,830	50,307	99	424
Forestry.....	11,763	11,677	—	86
Trade and Industries.....	113,171	99,568	11,624	1,979
Mines.....	3,037	3,032	—	5
Commerce and Transportation....	118,178	117,845	329	4
Employees of the Insular Govern- ment.....	12,850	12,777	62	11
Total.....	2,857,401	1,594,360	619,290	643,751

^a From the Philippine Bureau of Labor Bulletin 26: 30. Issued March, 1927.

This shortage of farm hands is a serious situation not only for the farmer but for the industries as well. We can not expect to depend upon farm-labor-saving machines for many years to come as their use in this country under the present conditions is very expensive and, in most cases, far from being practical. We will, therefore, continue to demand human labor, both men and women, to help produce the agricultural crops, most of which are necessary for our existence. Our present problem then is to

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effect a uniform distribution of agricultural labor throughout the farming communities and to devise ways by which the future demand for such labor can be supplied.

Why is there a shortage of farm labor? Why is this shortage more serious in some parts of the country than in others? How can this condition be improved? These are some of the questions to be considered.

Before satisfactory answers can be given to these questions inquiry must be made into the different phases of our agricultural labor supply. The agricultural labor conditions in the Islands must be considered.

SOURCES OF AGRICULTURAL LABOR SUPPLY

The labor supply of a country comes from two general sources: namely, (1) native population; and (2) immigration. Agricultural labor supply is no exception. Let us consider these sources of labor supply as applied to Philippine agriculture.

Native population

Our native farm hands are made up of two groups. One group is the sons of farmers who remain and work on the farm with a view to owning land and becoming independent farmers. This group of agricultural laborers, according to Ely, retains its social position because laborers belonging to it are treated in the same way as their fathers. It is the most desirable class of farm hands. Unfortunately, in the Philippines there is a constant drain on the number of farm laborers from this class. The desire for education and the attractions of city life, supported by the unwise ambition of the Filipino father to see his son have what he thinks is an easier job than his own, has taken many sons of farmers away from the country to the large towns and cities. These boys seldom return to the farm. Moreover, for the most part, it is the best of the young men that leave the farms. Those with the poorer qualifications, both mentally and physically, are too often the ones who stay in the home barrios. The result is that the general intelligence of our rural population remains at a standstill, a condition which makes it very difficult to persuade the farmers to change their old methods of farming.

The second group of native farm hands consists of those migratory or casual agricultural laborers who drift from city to country and back again, or from one occupation to another. The laborers belonging to this class form the great majority of our farm hands. Fortunately for us, most of our laborers from this class are from crowded rural communities; consequently, with proper encouragement many may be induced to settle permanently upon the land.

As the local agricultural laborers in many regions are far from being sufficient, the migratory laborers from densely populated districts should be encouraged to go where there is a demand for them. There is a surplus

labor population in the most densely populated provinces of the Archipelago, but there is no effective organized method to move them to the communities where there is a shortage of labor, especially at certain seasons.

Director Cruz (1927) of the Bureau of Labor in speaking on Labor Recruiting says that the Philippine Islands has about 3,000,000 persons available for agricultural work, or 25 per cent of the whole population. He further states that the country has 600,000 migratory laborers, a number large enough to meet the needs of the farmers provided there was an effective method of distribution.

The seasonal migration of farm laborers in the Philippines is natural, and is due principally to the unequal distribution of our population and the cultivation of seasonal crops which are highly specialized in certain regions. The surplus labor in the most densely populated regions is forced to go to places where there is demand for labor. As the seasonal crops are planted and mature in different months of the year the laborers who finish the work at home go to other places where their help is needed.

Reports of the Bureau of Labor summarize the seasonal migration movement of agricultural laborers in the Philippine Islands as follows:

1. Ilocos provinces to the tobacco regions in the provinces of Cagayan and Isabela.

2. Ilocos provinces and La Union to the rice region of Central Luzon, consisting of the provinces of Pangasinan, Nueva Ecija, Tarlac, Bulacan, and to the sugar haciendas in Pampanga and Laguna.

3. Iloilo, Antique, and Cebu to the sugar districts of Occidental Negros.

4. Cebu, Bohol, and the subprovince of Siquijor to the abaca plantation of Mindanao.

5. Capiz to Mindoro; Batangas to Mindoro, Laguna, and Tayabas; and Pampanga to Mindoro.

Table 2 shows the possible sources of agricultural labor supply in the Philippine Islands.

Notwithstanding this natural movement of agricultural labor, farmers in isolated regions sustain heavy losses owing to delay in planting, harvesting or marketing because of lack of hands to help them. Here lies the real problem in our agricultural labor supply. An effective way of moving this labor supply to regions where it is needed should prevent these losses, consequently adding to our production. Living conditions and wages in our rural communities should be improved so as to attract laborers to stay, thus stabilizing the supply of farm hands.

Immigration

Statistics show that we have in the Philippine Islands an adequate supply of agricultural laborers. We, therefore, have no need of considering immigration as a source of our agricultural labor supply, at least for the present and probably for many years to come.

TABLE 2

Showing possible sources and supply of labor^a

PROVINCES	TOTAL POPULATION	LABORERS		
		Total number	Percentage procurable	Number available
Abra.....	82,616	19,919	15	2,988
Antique.....	164,367	22,884	10	2,288
Bataan.....	63,811	13,270	10	1,327
Batanes.....	8,214	4,484	12	538
Batangas.....	379,266	91,638	10	9,164
Bohol.....	400,622	95,283	12	11,434
Camarines Norte.....	57,465	6,805	5	340
Capiz.....	322,006	74,123	15	11,118
Cavite.....	168,048	33,050	12	3,966
Cebu.....	950,435	248,434	15	37,265
Ilocos Norte.....	238,140	83,525	12	10,023
Ilocos Sur.....	231,614	87,341	12	10,481
Iloilo.....	546,828	120,838	12	14,501
Laguna.....	217,780	48,801	5	2,440
La Union.....	171,367	63,646	12	7,638
Leyte.....	696,963	136,832	15	20,525
Marinduque.....	59,328	7,840	5	392
Mountain Province.....	313,405	40,930	15	6,140
Nueva Ecija.....	271,125	80,329	12	9,639
Oriental Negros.....	306,170	68,330	15	10,250
Pangasinan.....	628,506	176,178	12	21,141
Rizal.....	267,834	17,778	5	889
Samar.....	433,261	113,797	15	17,070
Sorsogon.....	205,899	50,635	12	6,076
Sulu.....	211,707	10,000	12	1,200
Tarlac.....	189,293	29,091	10	2,909
Total.....	7,586,070	1,745,781		221,742

^a From the Philippine Bureau of Labor Bulletin 26: 30. Issued March, 1927.

CONDITIONS AFFECTING OUR FARM LABOR SUPPLY

Emigration to Hawaii

The yearly exodus of thousands of Filipino agricultural laborers to Hawaii is a serious menace to the stability of our farm labor supply. Director Cruz of the Bureau of Labor reports that the Hawaiian Sugar Planters' Association has practically ceased importing foreign labor except from the Philippines. This report has partially caused the continuous outflow of Filipino laborers every year to Hawaii, a condition which has increased the number of Filipino laborers in that territory so largely that recent reports of Mr. Butler, the Secretary of the Hawaiian Sugar Planters' Association, state that about 25 per cent of the more than 40,000 Filipino laborers in

Hawaii do not have employment. The *Manila Daily Bulletin* of September 10, 1928, reported that many of the 600 Filipino laborers who left the Philippines for Hawaii in the early part of August, 1928, did not have work.

This exodus of Filipino laborers to Hawaii started in 1906. Eala (1927) reports that since that year to and including 1925, 74,896 Filipinos had emigrated to Hawaii. Those who returned during the same period numbered 15,519, leaving a difference of 59,377 who were supposed to be in Hawaii. Actually, there are 39,342 working men in Hawaii and approximately 2,890 women, making a total of 42,232. The majority of the laborers who go to Hawaii are Ilocanos, the others are from the Visayas, Cagayan, and Pangasinan.

The following tables show the movement of Filipino laborers to Hawaii and the United States:

TABLE 3
*Showing Filipino emigrants to Hawaiï, annually, from
1907 to 1925*

YEAR	TOTAL	MALE	FEMALE	MINORS
1907	230	188	20	12
1908-14	19,039	unclassified		
1915	2,150	1,777	180	193
1916	2,214	1,877	157	180
1917	2,598	2,191	178	229
1918	2,761	2,030	284	447
1919	3,804	3,188	319	297
1920	3,454	3,042	225	187
1921	6,814	5,748	628	438
1922	8,183	7,291	530	362
1923	7,261	4,520	1,797	944
1924	9,869	8,171	1,116	582
1925	6,519	6,104	256	159
Total	74,896	46,127	5,690	4,030

TABLE 4

Showing returning Filipino emigrants to the Philippine Islands from 1907 to 1925

YEAR	TOTAL	MALE	FEMALE	MINORS
1907	2	—	—	—
1909-14	159	unclassified		
1915	347	260	40	47
1916	465	342	64	59
1917	733	568	72	93
1918	841	645	65	131
1919	948	677	104	167
1920	1,281	1,093	75	113
1921	2,705	1,953	249	503
1922	1,593	1,309	81	203
1923	1,496	1,226	112	158
1924	2,195	1,730	204	261
1925	2,754	2,183	264	307
Total	15,519	11,986	1,330	2,042

TABLE 5

Showing the number of Filipino laborers remaining in Hawaii after the expiration of their contract with the Hawaiian Sugar Planters' Association

YEAR	WENT TO HAWAII	RETURNED TO P. I.	REMAINED IN HAWAII	PERCENTAGE OF THOSE REMAINING TO TOTAL
1907	230	2	228	99.13
1909-14	19,039	159	18,880	99.16
1915	2,150	347	1,803	83.86
1916	2,214	465	1,749	79.00
1917	2,598	733	1,865	71.79
1918	2,761	841	1,920	69.54
1919	3,804	948	2,856	75.08
1920	3,454	1,281	2,173	62.91
1921	6,814	2,705	4,109	60.30
1922	8,183	1,593	6,590	80.53
1923	7,261	1,496	5,765	72.61
1924	9,869	2,195	7,674	77.76
1925	6,519	2,754	3,765	57.75
Averages	4,161	862	3,298	76.11

(NOTE:—Tables 3, 4, and 5 were taken from the Bulletin of the Bureau of Labor, 26: 18-19. Issued March, 1927.)

It is obvious from reasons given by Robb (1927) and Eala (1927) that the Filipino laborers emigrate primarily for economic reasons. The social causes mentioned are insignificant and temporary and can not be taken as sufficient reasons for a laborer to leave his home. The Filipino laborers who leave their country to go to Hawaii have a strong desire to better their circumstances, to improve their living conditions. In Hawaii, planters pay higher wages than can be obtained in the Philippines; provide many privileges as comfortable houses, free medical and hospital attendance, schools, fuel, water, land for gardens, also conveniences for deposit of savings. This treatment is not offered in the Philippine Islands, hence, it is but natural for our farm laborers to emigrate to that territory where opportunities for a better standard of living and for accumulation of capital await them.

This continuous outflow of Filipino laborers to Hawaii "constitutes a great subtraction from the productive energy of the country". Owing to lack of farm hands to help them during their rush seasons, Philippine sugar planters made a move, six years ago, to secure the passing of a bill in the Legislature lifting the ban on Asiatic immigration. This move was not based on an understanding of the real condition of our farm labor supply. These planters learned that there are enough farm workers in the Philippines, but there is no organized means of moving them to regions where they are wanted. Also that the wages and conditions of living offered on the sugar plantations are no inducement for labor to go to them. Our planters, not only of sugar but of other crops, will have to meet all the demands of labor today as to wages and living conditions, or in other words compete with what other countries offer, if our emigration is lessened.

Differences in wages

Labor, like all other commodities, is governed by the law of supply and demand. The greater the demand for labor the higher the wages paid to laborers provided the supply remains constant, and vice versa. Laborers tend to move to places where wages are higher than those offered them at home. The difference in wages offered to agricultural laborers in the different rural communities in the Philippine Islands has something to do with the uneven distribution of our agricultural labor supply.

Table 6 shows the relative wages, by provinces, of unskilled agricultural laborers in the Philippine Islands.

The table shows that the average daily wages of unskilled agricultural laborers in the most densely populated provinces, such as Cebu, La Union, Ilocos Norte, Ilocos Sur, Capiz, and Iloilo are very much lower than those offered in the sparsely settled provinces of Cagayan, Davao, and Isabela. There is considerable surplus labor in the thickly populated provinces, hence, wages are lower than in the sparsely settled regions where the labor supply is less than the demand.

TABLE 6
*Relative rates of wages of unskilled agricultural laborers by
 provinces in the Philippine Islands. 1925*

PROVINCES	AVERAGE DAILY WAGES			
	Adults		Minors	
	Male	Female	Male	Female
	P	P	P	P
Abra.....	0.55	0.35	0.30	0.22
Agusan.....	0.70	0.48	0.47	0.35
Albay.....	0.67	0.30	0.34	0.22
Bataan.....	1.12	0.61	0.58	0.50
Batanes.....	0.57	0.25	0.31	0.20
Batangas.....	0.92	0.56	0.54	0.38
Bohol.....	0.60	0.35	0.33	0.23
Bukidnon.....	0.59	0.50	0.30	—
Bulacan.....	1.13	0.73	0.60	0.49
Cagayan.....	0.77	0.58	0.47	0.39
Camarines Norte...	1.01	0.45	0.40	0.35
Camarines Sur.....	0.80	0.37	0.38	0.24
Capiz.....	0.54	0.33	0.29	0.23
Cavite.....	1.00	0.74	0.65	0.57
Cebu.....	0.45	0.32	0.28	0.22
Cotabato.....	1.85	0.65	0.40	0.40
Davao.....	1.04	0.68	0.57	0.44
Ilocos Norte.....	0.80	0.47	0.32	0.32
Ilocos Sur.....	0.66	0.41	0.37	0.28
Iloilo.....	0.61	0.41	0.38	0.29
Isabela.....	1.04	0.62	0.60	0.45
Laguna.....	1.19	0.78	0.69	0.52
Lanao.....	0.80	0.35	0.55	0.35
La Union.....	0.85	0.42	0.50	0.34
Leyte.....	0.66	0.38	0.36	0.24
Marinduque.....	1.15	0.55	0.70	0.36
Mindoro.....	0.86	0.60	0.48	0.40
Misamis.....	0.69	0.47	0.46	0.32
Mountain Province.	0.48	0.40	0.33	0.29
Nueva Ecija.....	0.82	0.58	0.48	0.42
Nueva Vizcaya.....	0.91	0.56	0.38	0.36
Occidental Negros..	0.78	0.51	0.46	0.35
Oriental Negros....	0.57	0.39	0.32	0.24
Palawan.....	0.78	0.54	0.40	0.30
Pampanga.....	1.02	0.74	0.67	0.53
Pangasinan.....	0.77	0.53	0.48	0.40
Rizal.....	0.97	0.77	0.68	0.64
Romblon.....	0.67	0.33	0.33	0.23
Samar.....	0.65	0.38	0.35	0.25
Sorsogon.....	0.80	0.36	0.40	0.25
Sulu.....	0.40	0.30	—	—
Surigao.....	0.79	0.52	0.48	0.35
Tarlac.....	0.83	0.54	0.54	0.39
Tayabas.....	1.08	0.84	0.74	0.41
Zambales.....	0.85	0.56	0.50	0.35
Zamboanga.....	1.06	0.36	0.31	0.25
Average.....	0.82	0.49	0.45	0.35

It is, however, interesting to note that Occidental Negros, the province which often complains of insufficiency of laborers, offers an average daily wage of only 78 centavos, while in La Union, a densely populated province, it is 85 centavos. Regions, then, that suffer from shortage of farm hands should raise the wage offered high enough to induce laborers to come there. Otherwise these regions can not hope to secure a satisfactory supply of laborers.

The village system of settlement

Miller (1920) states that the village system of settlement by the Filipinos dates back to the coming of the Malayan peoples to the Archipelago. This system was encouraged by the Spaniards because it facilitated their work in Christianizing the natives and made it easy to govern them. Today, the uneven distribution of the population of the Archipelago is largely a result of this system of settlement. When a group of families settle in a place they stick to that settlement even if it becomes so crowded that scarcely enough food can be raised from the area to supply the community. Younger members of these families move away only when conditions following over-population compel them to.

The geographical situation of the country

The peculiar geographical situation of the Archipelago is another cause for the unequal distribution of our farm labor supply. Some islands are crowded because they were settled early while others are still sparsely settled or uninhabited. In order to make easy the migration of people from one island to another, the interisland steamship service throughout the Archipelago should be made more efficient. The rates should be low enough to permit migratory laborers to move to places where they are greatly needed.

Absence of good roads

The lack of good roads often isolates certain agricultural regions from the rest of the country. This makes the moving of labor supply to these regions difficult, resulting in their remaining in a backward condition.

School term coincides with working season

The long vacation of all pupils in schools throughout the Philippine Islands falls during March, April, and May, the months when there is practically nothing to be done on the farm. Without giving thought to the question, our young people have been criticized for doing nothing at home during vacation. The young people are not to blame for their idleness. When they go home they find their parents doing nothing, for it is the idle season on the farm. To correct this situation, our educational authorities should take this idle season into consideration and change the school term schedule. The long vacation should coincide with the principal planting season of food crops, such as rice, etc.; then the students would be able to

assist their parents. With this plan, students could be of service not only with their work but by introduction of the principles they learn in farm and other schools in the work on their parents' farms. This would hasten the adoption of new methods in agriculture by our conservative farmers.

These are some of the conditions affecting the distribution of our farm labor supply. What have our farmers done to improve these conditions? Has our Government given the farmers any help towards bettering farm labor conditions?

ATTEMPTS TO SOLVE OUR FARM LABOR PROBLEM

Discourage emigration to Hawaii

The Bureau of Labor has been trying to lessen the number of Filipino laborers going to Hawaii. Recently, the Director of this bureau required all labor agents to file bonds with the Government before they could recruit laborers. Very strict regulations are also being enforced upon the laborers who wish to go to Hawaii. For example, the boats chartered to carry laborers to that territory are required to meet certain regulations imposed upon them by the Bureau of Customs; medical examination of all laborers is also required before they can sail.

Despite these efforts of the Government to discourage emigration, there has been in increasing numbers a continuous outflow of Filipino agricultural laborers to Hawaii. During the first week of August, 1928, there were 955 Ilocano laborers who sailed on two steamers bound for Hawaii.

As it is impossible to legally prevent these people from going abroad without curtailing their freedom, the only way to diminish the number is to attract them to stay on our plantations or induce them to settle upon our public domain. This might be done in two ways; namely, (1) by offering as high wages comparatively as is offered in the Hawaiian plantations and by giving the laborers similar comforts, privileges, and amusements; and (2) by preaching to these laborers that it is not to their advantage to go abroad. The first is self-explanatory. The second can be effectively carried out by giving more power to the Bureau of Labor so that it can stop unauthorized labor agents encouraging laborers to go abroad at their own expense. Only laborers who have been contracted to work on the Hawaiian sugar plantations by the Hawaiian Sugar Planters' Association should be allowed to emigrate. Those who wish to go to that territory at their own expense and who go there to speculate on getting a job should not be permitted to sail unless they are assured by the Labor Commissioner in Hawaii that there is work waiting for them. Agents of the Bureau of Labor should be sent to the provinces from where most of these emigrants come to tell the people about the advantages of staying at home and helping in the development of our own natural resources.

The Government is making some effort to induce labor to stay in the Philippines by offering free transportation to settlers from their homes to

places where they can make settlements through Government aid. The Government also induces laborers to settle in colonies that are established for the purpose of increasing the agricultural production of the country. Such colonies are located in isolated and unoccupied regions in the country. Laborers are given free transportation, free holdings, and advances in the form of money, implements, and work animals, provided they stay and work on the land settlements assigned to them. These plans by the Government tend to equalize the distribution of the population of the country but affect only a relatively small number.

Increase wages and offer continuous work

During one of the annual conventions of the Philippine Sugar Association some one suggested that lowering of wages is one way of reducing the cost of sugar production in the Islands. Theoretically, this is true, but sound economics does not warrant its application. It is claimed that our laborers are very poor workmen compared with the laborers in Hawaii and Cuba. This inefficiency is largely due to lack of good food, proper shelter, often lack of medical attention—these things give men extra energy in working. Our laborers can not afford to buy good food because their wages will supply only food enough to keep them alive. Laborers in Hawaii and Cuba are paid more in actual cash besides the comforts provided, hence, their standard of living is higher, and they can do more work.

If we wish to increase the efficiency of our laborers, we should make a higher standard of living possible. They should be paid wages high enough to enable them to buy sufficient good food that they may have the strength to do hard work. Furthermore, increasing the wages of our laborers will tend to reduce the cost of production per unit of labor in the industry where they are employed.

Another thing that makes farm labor supply a problem in some of our agricultural regions is the lack of continuity of employment owing to lack of work during certain seasons of the year. Laborers are employed only during the planting and harvesting seasons. Between these seasons they are discharged because their employers have no work for them. Consequently, these laborers have to move to other places where they can find work during these idle seasons. Now, the uncertainty of weather conditions and the lack of transportation facilities make uncertain the coming back of these laborers to the same place. This situation often causes shortage of labor in some regions. This, in turn, results in decreased production.

Our planters, especially the sugar planters, should endeavor to furnish their laborers with continuous work throughout the year. This can be done either by practicing diversified farming as is being done on the Canlubang Sugar Estate where there are coconut and coffee plantations in addition to the sugar plantations, or by continuous cropping as is practiced

in Cuba where sugar crops stay on the plantations for as long as twenty years.

The offering of continuous work, however, is desirable only in regions where laborers are paid in cash or are employed by contract. In places where they are paid by a percentage of the produce, as is the practice in the rice regions where laborers get from 10 to 25 per cent of the crop depending on the supply of labor, laborers can not be prevailed upon to stay after the harvest season. They go back to their homes because they migrated to the rice region only after their farm work at home had been finished.

Improvement of roads

In the large islands, as Luzon, there are isolated places which often experience heavy losses in agricultural products because of lack of farm hands. These places would not have any difficulty in securing a labor supply if they were connected with the densely populated regions by good roads. The San José-Santa Fe road illustrates the possible effect of roads on labor supply. Before it was built people from the thickly populated Central Plain of Luzon and from the Ilocos provinces could go to the sparsely settled Cagayan Valley only with difficulty. People of the Valley could raise only tobacco and corn in rotation. They imported rice from Pangasinan and Nueva Ecija through the seaport, Aparri. Now, throughout the Valley people are beginning to plant rice. They can do this because migratory laborers can reach that region by truck or automobile over the San José-Santa Fe road.

As the migration of our laborers is seasonal and as our labor supply on the farm depends to a large extent on this class of agricultural laborers, good roads should be built as fast as possible connecting all isolated regions with the densely populated districts that have a labor supply.

SUMMARY

There are 2,547,572 agricultural laborers in the Philippine Islands, or less than one laborer for every hectare of the 3,703,700 hectares under cultivation. In addition to this number we have about 600,000 migratory agricultural laborers, a number sufficient to meet the demand of our farmers.

Our agricultural labor supply is largely dependent upon the migratory laborers, but conditions peculiar to the country often cause shortage of farm hands in certain regions. These conditions are:

1. The emigration of Filipino laborers to Hawaii which has been going on continuously since 1906 is a serious menace to the stability of our farm labor supply. This continuous outflow of Filipino farm hands from the Islands could be stopped by: (a) offering to these laborers as high wages, comparatively, and providing them with conveniences, such as free housing, free fuel, free water, free medical treatment, facilities for saving, etc., as is offered them by the Hawaiian planters; and (b) encouraging them

to settle upon the vast unoccupied public domain; that is, induce them to take up homesteads or settle in the Government colonies already established in certain parts of the country. This latter scheme tends to equalize the distribution of our population, thereby eventually helping to stabilize our farm labor supply.

2. The low wages offered laborers in certain agricultural regions, such as in the Negros sugar plantations, do not attract migratory laborers from the densely populated provinces to go there for work. Wages in such regions where the labor supply is insufficient to meet the demand of the farmers should be made high enough to attract migratory laborers, thus preventing the recurrence of losses because of lack of farm hands.

3. The gregariousness of the Filipino people explains why the labor supply is plentiful in certain regions in the country while it is scarce in others. Some parts of the Islands are very densely populated while other parts are unoccupied or sparsely peopled. This habit could be eliminated in time. As the people advance in civilization they become more and more ambitious and their views are broadened thus making them see the disadvantages of living in crowded settlements which yield hardly enough for their support.

4. The peculiar geographical situation of the Archipelago makes it hard for migratory laborers to reach certain regions, thus causing shortage of farm hands in places. Cheap and efficient inter-island steamship service would relieve this situation.

5. The present system of having the schools open throughout the country during the busy seasons on the farms, that is planting and harvesting seasons, draws off of the farms many boys and girls whom might be of great help to their parents. The vacation of all schools in the country should coincide with the planting or harvesting season of crops, such as rice, sugar, etc., so that the boys and girls in schools could help their parents. This would add to the labor supply in the agricultural regions.

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A FUSARIUM CAUSING BULB ROT OF ONION IN THE PHILIPPINES¹

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WITH FOUR PLATES AND FOUR TEXT FIGURES

INTRODUCTION

On December 28, 1926, a bundle of diseased onions was brought to the attention of the writer. The onions came from Lemery, Batangas Province. The plants showed yellowing and dying-back of the leaves. The bulbs were soft and showed a semi-watery decay. Microscopic examination of tissues from the margin of the infected portion revealed an abundance of fungous hyphae. Conidia were found in the slimy mass of rotted tissues. They were either septate or non-septate and were typical of those of *Fusarium*. The causal fungus was isolated by the writer and first proved pathogenic on Singapore Red onion.

THE DISEASE

History and geographical distribution

According to Walker and Tims (1924) reports of the *Fusarium* bulb rot of onion were made from Ohio in 1910 by Selby, from Japan in 1914 by Hanzawa, and from Connecticut in 1915 by Clinton. Walker and Tims (1924) found that the bulb-rot of onion occurs in the northern Mississippi Valley and identified its causal agent with *Fusarium cepae* Hanzawa. According to Link and Bailey (1926) the fungus described by Walker and Tims as *F. cepae* Hanzawa emend. Walker and Tims is *F. zonatum* forma 1 (Sherb.) Wr. Link and Bailey (1926) report several species of *Fusarium* as occurring in the rotting bulbs of onions which they obtained from the fields, markets, and storage of practically all the large onion-growing sections in the United States and from Egypt and Spain. These authors report that *F. cepae* Hanzawa and *F. zonatum* (Sherb.) Wr. are always pathogenic, *F. bulbigenum* Cke. and Mass. and *F. moniliforme* not consistently pathogenic, and *F. oxysporum* (Schlecht.) Wr. and *F. vasinfectum* Atk. not patho-

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²The writer is indebted to Dr. G. O. Ocfemia of the Department of Plant Pathology for some valuable suggestions during the course of this investigation and in the preparation of the manuscript.

genic. The other species of *Fusarium* that they isolated from the decayed onion bulbs did not prove pathogenic. They further found that most of the pathogenic species of onion bulb rot *Fusarium* belong to section *Elegans*.

Thus far the bulb rot of onion is known to occur only in the United States and Japan and probably in Egypt and Spain where Link and Bailey (1926) obtained some of their materials, and in the Philippines.

Economic importance

According to Walker and Tims (1924) the *Fusarium* bulb rot of onion is one of the most serious diseases in certain onion fields in the United States. The enormity of loss in the field, in storage, and in transit warrants a careful study of the disease and its control measures.

Link and Bailey (1926) noted serious field losses caused by bulb rot in the onion fields in Colorado in 1920. They also found that bulb rot was a serious menace in the onion shipments from Texas in 1922 and was an increasingly serious factor in the production and marketing of onions at Walla Walla, Washington.

There has been no report published on the *Fusarium* bulb rot of onion in the Philippines. But in 1925 the attention of Professor Raymundo of the Agronomy Department in this College, was attracted by the serious damage caused by this disease in an onion field in the Experiment Station. He estimated the loss to be about 40 to 50 per cent of the crop. The writer found that the loss in an onion field attacked by rots caused by *Fusarium* and *Sclerotium* in Lemery, Batangas, was from 40 to 60 per cent. Onions in Batangas are planted in November or a few weeks after the close of the rainy season. The writer was informed by some onion growers in Lemery that the rotting of onion bulbs which they call *pasik* occurs in many fields every year, especially if the soil is dampened by occasional December and January showers. Presumably, these growers plant either infected bulbs or healthy ones in a "Fusarium-sick soil."

Symptoms

The characteristic symptoms of the disease are the yellowing and dying-back of the leaves starting from the tips. Complete yellowing and subsequent drying out of leaves take place in five to ten days, depending upon the length and size of leaves and severity of infection.

Before the symptoms are shown on the aerial parts of the plants, rotting has started either in the bulb, true stem, or root system. General rotting of the onion bulb starts from the true stem. White moldy growth is often found on the rotted scales.

In an advanced stage of infection the bulbs show a semi-watery decay. The surface of the rotting scales is slimy to the touch. The mycelium of the causal fungus is present in the affected part of the bulb. Maggots³, bacteria.

³According to Mr. S. M. Cendaña of the Department of Entomology, College of Agriculture, the maggots are larvae of certain flies.

and nematodes are oftentimes found in the decayed tissues. The writer believes that the broken-down tissues of onion bulbs caused by *Fusarium* make a good substratum for the growth and multiplication of bacteria, nematodes, and other soil organisms in the field. These organisms cause rapid rotting of broken-down tissues.

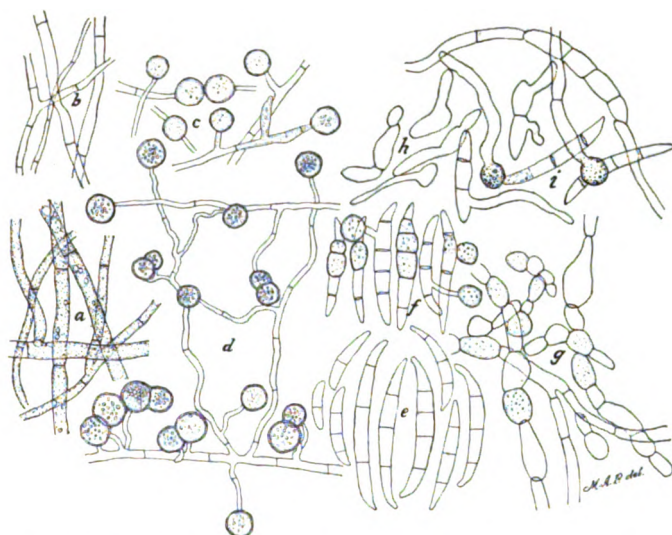


Fig. 1.—Camera-lucida drawings of *Fusarium zonatum* (Sherb.) Wr. forma 1 showing (a) Mycelium from a 48-hour culture on potato-dextrose agar. $\times 560$. (b) Mycelium from a 6-month old culture on potato-dextrose agar. $\times 560$. (c) Hyphal chlamydospores from a sporodochium of 1½-month old culture on hard oatmeal agar. $\times 430$. (d) Hyphal chlamydospores from pinnules of a 14-day old culture on corn meal agar. $\times 430$. (e) Septate conidia from sporodochium of a 1½-month old culture on hard oatmeal agar. $\times 420$. (f) Different forms of conidial chlamydospores from sporodochium of a 1½-month old culture on hard oatmeal agar. $\times 430$. (g) Sclerotium like cells from a 3-month old culture on beef extract agar. $\times 430$. (h) Germinating conidia. $\times 1120$. (i) Germinating conidial chlamydospores. $\times 560$.

CAUSAL ORGANISM

Method of isolation and preparation of subcultures

The bulb which showed an early stage of infection was soaked in 1:1000 mercuric chloride solution for two minutes. The solution was then washed off with sterile water. The outer scale was taken off and the innermost infected parts were cut with a flamed scalpel and plated out on sterile potato-dextrose agar. Transfers were made on slants of hard oatmeal agar from the pure colonies. The cultures on the different media were made by diluting the spores from the sporodochium in water and then inoculating each culture tube with a loopful of the spore-suspension.

Morphology

Mycelium. The mycelium of a young culture appears as fine, white threads. It is granular and vacuolate as shown in figure 1a. The branches are laid at wide intervals often above 200 μ . The hyphal cells are short. A great majority of the hyphal cells are below 20 μ in length. They vary from 7 μ to 35 μ in length and from less than 2 μ to 4.6 μ in width. The hyphae of an old culture are less granular as shown in figure 1b. Many of them appear to be empty.

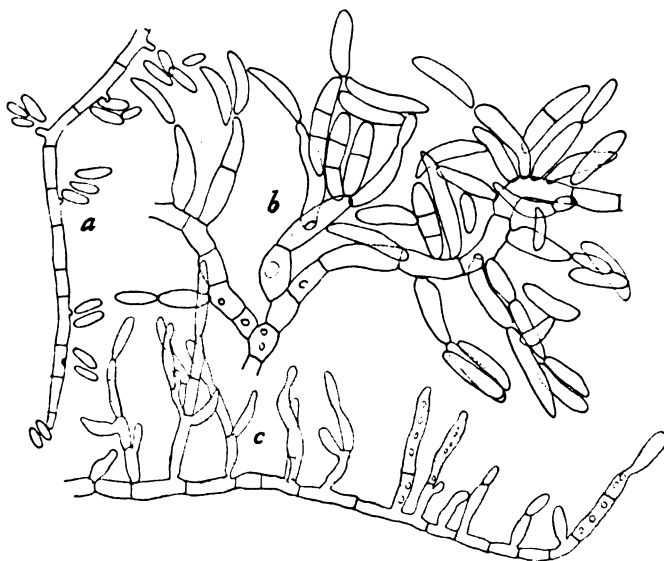


Fig. 2.—Camera-lucida drawings of *Fusarium zonatum* (Sherb.) Wr. forma 1 showing (a) Conidiophores originate as small projections on the side of the hyphal filament and bear usually 0-septate conidia. $\times 430$. (b) Conidiophores bearing large and septate conidia. $\times 560$. (a) and (b) from a 26-hour-old hanging-drop preparation in potato-dextrose agar. (c) A hyphal thread from a 3-day-old culture on soybean-dextrose agar showing the formation of long branched conidiophores. $\times 430$.

Conidiophores. The conidiophore and conidium-formation were studied from a hanging drop preparation in potato-dextrose agar. The conidiophores develop within 15 hours in culture. They are produced by the aerial hyphae or in the pionnotes. They appear as short lateral branches of the mycelium. They are granular and vacuolate while young and are constricted at the points of origin.

There were three or more types of conidiophores observed in hanging drop preparation. The first of these types are those which appear as small lateral protrusions of the hyphae. They generally bear the non-septate conidia (fig. 2a). It was also observed that those minute projections produce both the septate and nonseptate conidia (fig. 3c) and in a few cases only large and septate conidia (fig. 3b) are borne by them.

Club-shaped conidiophores arise singly or in groups from the hyphal cells. They are constricted at the points of origin, slightly enlarged at the middle and then taper gradually toward the rounded ends. They measure from 8 to 10 μ in length and from 3 to 5 μ at the widest diameter. Some of these club-like conidiophores are divided into segments and they generally bear the large and septate conidia.

Branched and dendroidal conidiophores have been observed oftentimes from the pionnotes. The branches arise singly or in groups below each septum (fig. 2c.) The dendroidal conidiophores (fig. 3a) bear generally the large and septate conidia. The conidiophores appear to be less granular and empty after they have produced numerous conidia.

Conidia. The conidia may be found in even less than a 24-hour-old culture. An initial conidium appears as a small swelling above a constriction at the end of the conidiophores. This incipient conidium grows out rapidly in length but slowly in width. When it has reached its characteristic shape and size, a septum is laid out at the constriction. The mature conidium is detached and pushed either upward or aside as soon as another conidium is produced on the same conidiophore. The writer had occasion to observe two conidiophores producing the septate conidia at an average rate of one in about an hour until three were formed. The rate of conidium-formation varies from less than an hour to more than two hours. Septation of the conidia takes place several hours after their detachment from the conidiophores. In some culture media it takes place after a few days.

The spores vary in shape, size, and septation. The septa vary from zero to eight. Conidia with as many as six to eight septa were rarely noted. The 0-septate conidia are as abundant as the septate conidia on a few agar media. Mostly septate conidia are found in the rotting tissues of onion bulb.

The septate conidia are generally sickle-shaped, apically attenuate, apedicillate to slightly pedicillate (fig. 1e). Some are, however, nearly straight. The septa are typically three and rarely more or less than this number. They are granular while young but with age they gradually lose this character.

The 0-septate conidia are generally ellipsoidal. A few 1- to 2-septate conidia have also this shape.

The measurements⁴ of spores on different media are as follows:

On oatmeal agar with 2 per cent dextrose, 17 days old

4-septate, 28 to 32 by 4.0 μ (3)⁵, 30 by 4 μ average

3-septate, 20 to 36 by 2.4 to 4.8 μ (35), 27.7 by 3.8 μ average

2-septate, 18 to 28 by 2.4 to 4.0 μ (9), 21.8 by 3.1 μ average

1-septate, 14 to 24 by 2.0 to 3.6 μ (4), 16.4 by 2.7 μ average

0-septate, 4 to 14 by 1.2 to 3.6 μ (50), 7.3 by 2.0 μ average

⁴Only spores obtained from pionnotes were measured. No effort was made to determine the relative abundance of spores of different septation on the different media.

⁵Numbers in parentheses indicate number of spores measured.

On oatmeal agar without dextrose, 14 days old

- 4-septate, 31.2 by 4.4 μ (1)
- 3-septate, 24.0 to 44.8 by 3.6 to 4.8 μ (22), 34.3 by 4.1 μ average
- 2-septate, very rare if any
- 1-septate, 10 to 24 by 2.4 to 4.4 μ (5), 15.6 by 3.4 μ average
- 0-septate, 4 to 14 by 2.0 to 4.0 μ (47), 9.1 by 3.1 μ average

On corn meal agar with 2 per cent dextrose, 28 days old

- 4-septate, 38 to 40 by 4 to 4.4 μ (3), 37.3 by 4.1 μ average
- 3-septate, 20 to 44 by 3.2 to 4.4 μ (34), 32.2 by 3.9 μ average
- 2-septate, 20 to 30 by 3.2 μ (2), 25 by 3.2 μ average
- 1-septate, 11.2 to 22 by 2.8 to 3.2 μ (12), 18.2 by 3 μ average
- 0-septate, 4 to 10 by 1.6 to 4 μ (50), 7.4 by 2.9 μ average

On corn meal agar without dextrose, 28 days old

- 5-septate, 42 by 4.4 μ (1)
- 4-septate, 40 to 48 by 4.4 to 4.8 μ (3), 44 by 4.4 μ average
- 3-septate, 18 to 46 by 3.2 to 4.8 μ (34), 35.9 by 4.4 μ average
- 2-septate, 18 to 20 by 3.2 μ (3), 18.6 by 3.2 μ average
- 1-septate, 12 to 20 by 2.8 to 3.2 μ (8), 17 by 3.1 μ average
- 0-septate, 4 to 12.8 by 2 to 3.2 μ (17), 8.4 by 2.6 μ average

On onion decoction agar with 2 per cent dextrose, 25 days old

- 4-septate, 36 to 44 by 4 to 4.4 μ (4), 38.5 by 4.3 μ average
- 3-septate, 20 to 46.8 by 3.2 to 4.8 μ (34), 34.9 by 4.1 μ average
- 2-septate, 16 to 26 by 2.8 to 4 μ (9), 21.8 by 3.5 μ average
- 1-septate, 16 to 28 by 3.6 to 4 μ (3), 20.6 by 3.7 μ average
- 0-septate, 4 to 12 by 1.6 to 4.4 μ (50), 7.4 by 2.9 μ average

On onion decoction agar without dextrose, 28 days old

- 5-septate, 44 by 4.4 μ (1)
- 4-septate, 43.2 to 48 by 4 to 4.8 μ (7), 45.3 by 4.1 μ average
- 3-septate, 18 to 44.8 by 3.2 to 4.4 μ (25), 35.2 by 3.9 μ average
- 2-septate, 16 to 32 by 3.2 to 4.4 μ (10), 19.9 by 3.7 μ average
- 1-septate, 7.2 to 20 by 2.4 to 4.4 μ (13), 13.3 by 3.3 μ average
- 0-septate, 4 to 10 by 1.6 to 4.4 μ (49), 6.2 by 2.6 μ average

On soybean agar with 2 per cent dextrose, 1 month old

- 5-septate, 36 to 40 by 4 to 4.4 μ (2), 38 by 4.2 μ average
- 4-septate, 36 to 40 by 4 to 4.8 μ (3), 37.3 by 4.5 μ average
- 3-septate, 22 to 40 by 3.2 to 4.8 μ (36), 29.9 by 3.9 μ average
- 2-septate, 16 to 22 by 3.2 to 3.6 μ (5), 18.9 by 3.3 μ average
- 1-septate, 15.2 to 18 by 3.2 μ (4), 17.1 by 3.2 μ average
- 0-septate, 4 to 12 by 1.6 to 4 μ (50), 7.2 by 2.8 μ average

On soybean agar without dextrose, 21 days old

- 4-septate, 32 to 40 by 4 to 4.4 μ (5), 36 by 4.3 μ average
- 3-septate, 22 to 40 by 3.2 to 4.8 μ (93), 32.8 by 4.1 μ average
- 2-septate, 20 by 3.6 μ (1)
- 1-septate, 18 to 20 by 3.2 to 3.6 μ (2), 18.8 by 3.4 μ average
- 0-septate, 4 to 10 by 1.6 to 4.8 μ (50), 6.8 by 2.7 μ average

On beef extract agar with 2 per cent dextrose, 9 days old

- 4-septate, 32 to 44 by 2.8 to 4 μ (12), 38.4 by 3.4 μ average
- 3-septate, 18 to 48 by 2.4 to 4 μ (82), 30.4 by 3.4 μ average
- 2-septate, 16 to 20 by 2.4 to 3.6 μ (7), 18.8 by 3.1 μ average

1-septate, very rare

0-septate 4 to 12 by 1.6 to 4 μ (30), 9.7 by 2.6 μ average

On beef extract agar without dextrose, 7 days old

8-septate, 60 by 6.8 μ (1)

7-septate, 52 to 60 by 4.8 to 6.0 μ (2), 56 by 5.4 μ average

6-septate, 40 to 56 by 4.8 to 6.0 μ (7), 48.5 by 5 μ average

5-septate, 48 to 52 by 4.4 to 4.8 μ (2), 50 by 4.6 μ average

4-septate, 36 by 4.8 to 5.6 μ (2), 36 by 5.2 μ average

3-septate, 18 to 46 by 2.4 to 5.6 μ (80), 32 by 4.6 μ average

2-septate, 22 by 4.8 μ (1)

1-septate, 8 to 24 by 2.4 to 4.8 μ (12), 12.6 by 3.8 μ average

0-septate, 6 to 12 by 2 to 4.0 μ (50), 8.5 by 3.2 μ average

On potato-dextrose agar

5-septate, 44 to 52 by 4 to 4.4 μ (4), 49 by 4.3 μ average

4-septate, 44 to 48 by 4 to 4.4 μ (5), 46.4 by 4.1 μ average

3-septate, 18 to 38 by 3.2 to 4 μ (24), 32.4 by 3.9 μ average

2-septate, 15.2 to 16.8 by 3.2 μ (3), 16 by 3.2 μ average

1-septate, 8 to 18 by 2.4 to 4 μ (4), 10.8 by 3 μ average

0-septate, 4 to 8.8 by 2 to 3.2 μ (24), 5.7 by 2.6 μ average

On potato plugs, 1 month old

4-septate, 38 to 44 by 4 μ (4), 41 by 4 μ average

3-septate, 16 to 48.8 by 2.8 to 4.8 μ (40), 31.2 by 3.9 μ average

2-septate, 20 by 4 μ (1)

1-septate, 8 to 12 by 3.2 to 4 μ (6), 9.5 by 3.4 μ average

0-septate, 4.8 to 12 by 2 to 4 μ (42), 8.1 by 3 μ average

On corn meal, 1 month and 10 days old

4-septate, 36 by 4 μ (1)

3-septate, 16 to 39.2 by 3.2 to 4.8 μ (40), 30.7 by 4 μ average

2-septate, 15.2 to 20 by 2.4 to 4 μ (4), 22.4 by 3.6 μ average

1-septate, 16 by 4 μ (1)

0-septate, 4 to 10.4 by 1.6 to 3.6 μ (50), 7.6 by 2.6 μ average

The average measurements of the conidia on all media are as follows:

8-septate, 60 by 6.8 μ (1) (very rare)

7-septate, 52 to 60 by 4.8 to 6 μ (2), 56 by 5.4 μ average (very rare)

6-septate, 40 to 56 by 4.8 to 6 μ (7), 48.5 by 5 μ , average (very rare)

5-septate, 36 to 52 by 4 to 4.8 μ (10), 44.7 by 4.4 μ , average (very rare)

4-septate, 31.2 to 48 by 2.8 to 5.6 μ (43), 38.2 by 4.2 μ , average

3-septate, 16 to 48.8 by 2.4 to 5.6 μ (579), 32.3 by 4.0 μ , average

2-septate, 15.2 to 32 by 2.4 to 4.8 μ (55), 20.2 by 3.5 μ , average

1-septate, 7.2 to 28 by 2 to 4.8 μ (74), 15.5 by 3.3 μ , average

0-septate, 4 to 12 by 1.2 to 4.8 μ (559), 7.6 by 2.7 μ , average

The conidia were produced profusely on all media tested by the writer. The measurements of the spores given above seem to show that the presence of dextrose in the media does not stimulate the growth in size of the conidia. The conidia are in general larger on media without dextrose than those on media containing this sugar. But the growth of the fungus on media containing dextrose is a little faster and a little more luxuriant than on those without it as shown in table 1.

TABLE 1

*Comparative amount of growth on different agar media with and without dextrose in plate cultures of the Philippine onion bulb rot *Fusarium**

MEDIA	WITH DEXTROSE	WITHOUT DEXTROSE
	Average diameter of growth	Average diameter of growth
Beef extract agar.....	cm. 8.4	cm. 6.1
Corn meal agar.....	8.1	6.8
Oatmeal agar.....	8.0	7.6
Potato agar.....	7.0	5.5
Onion agar.....	5.4	4.5
Soybean agar.....	7.6	6.4



Fig. 3.—Camera-lucida drawing of *Fusarium zonatum* (Sherb.) Wr. forma 1 showing conidiophores from a 47-hour-old hanging-drop preparation in potato-dextrose agar. (a) Dendroidal conidiophore bearing the young large septate conidia (septation was observed later). (b) Conidiophores shown by mere minute projections and bear the large septate conidia. (c) Small protrusion bearing both the 0-septate and septate conidia. All drawings are $\times 560$.

Anastomosis of conidia was observed on some agar media. On hard oatmeal agar there were two to as many as seven conidia anastomose (fig. 4a). They were connected by hyaline tubes very often between end segments. The hyaline connections occurred also between an end segment of a conidium and a middle segment of another conidium.

A conidium germinates by the production of a germ tube or two germ tubes one at each end segment (fig. 1*h*) within eight hours. Before the conidium sends out its germ tube it swells a little and becomes constricted at the septa (fig. 4*b*). If the conidium bears a chlamydospore the germ tube arises from the chlamydospore and never from any other part of the conidium.

Chlamydospores. Hyphal and conidial chlamydospores were both produced. They are thick-walled, and granular. The writer believes that they are resting bodies of the onion-bulb rot *Fusarium*.

The hyphal chlamydospores are terminal and intercalary and are smooth and spherical (figs. 1*c* and *d*). They are produced both on aërial mycelium or in pionnotes in a culture tube of about 10 to 15 days old.

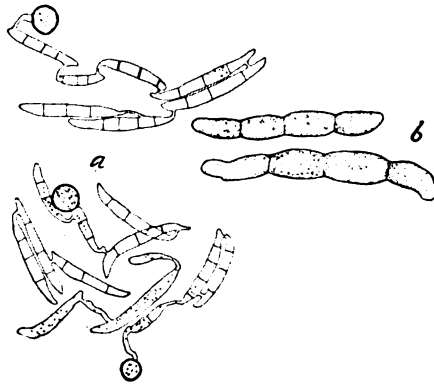


Fig. 4.—Camera-lucida drawings of *Fusarium zonatum* (Sherb.) Wr. forma 1 showing (a) Anastomosis of conidia from a 14-day-old culture on hard oatmeal agar. $\times 430$. (b) Conidia in their first stage of germination. $\times 560$.

They are unicellular to two-celled. Occasionally, they form chains of three to four or more cells. They vary from $6\ \mu$ to $10\ \mu$ in diameter and the average size of 275 bodies is $8\ \mu$.

The conidial chlamydospores are produced when the culture is about a month old. They are either central, terminal, subterminal, sessile, or borne on a stalk that arises from one of the segments of the conidium (fig. 1*f*). Those that are produced in the middle segment are either ovoid, barrel-shaped or spherical. Those that are terminal, subterminal, sessile, and those that are borne on stalks are, in general, spherical in shape. The conidial chlamydospores are seldom two- or three-celled. The measurements of 250 conidial chlamydospores of the ovoid and barrel-shaped types vary from $4\ \mu$ to $14\ \mu$ in length and from $3\ \mu$ to $8.4\ \mu$ in width. The average length falls between $7.8\ \mu$ and $8.0\ \mu$ and the average width is $5.2\ \mu$. The conidial chlamydospores of the spherical type measure from $4\ \mu$ to $10.2\ \mu$ in diameter. The average diameter of 250 of this type was $6.5\ \mu$.

Forms of fructification. Conidia are produced by the hyphae creeping on the surface of agar media or by the aërial threads. Macroscopically the aërial filaments appear as fine, powdered white threads when numerous conidia are produced by them. When myriads of these conidia have been produced by the mycelium the growth becomes compact. The conidia together with the fruiting branches form numerous minute, wart-like heaps of spores which appear slimy, especially in the presence of much moisture. They resemble the type of fructification which Sherbakoff (1915) calls *pseudopionnotes*. The bodies which resemble the pseudopionnotes of Sherbakoff merge together and converge into a continuous slimy mass of spores known as *pionnotes*. In a three-week-old culture on hard oatmeal agar where moisture is much less than in ordinary media the wart-like heaps of spores together with the conidiophores are large, elevated, and ochraceous salmon in color. These structures are similar to those termed *sporodochia* by Sherbakoff (1915).

Other characters of the Philippine onion bulb rot Fusarium. Certain abnormal characters of the mycelium were observed on some media. In a 6-day old culture on onion-decoction agar exceptionally large and swollen vacuolate hyphae were noted. Barrel-shaped sclerotium-like cells (fig. 1g) were observed from the pionnotes of a 3-month-old culture on beef-extract agar but no true sclerotia was formed on this medium.

Cultural characters

The growth is profuse on beef-extract agar, oatmeal agar, potato agar, onion agar, corn meal agar, potato plugs, and corn meal. It is thin on corn meal agar. Aërial mycelium is typically scanty on all agar media and especially so on oatmeal agar and corn meal. The growth is at first whitish but with age it becomes pale pinkish buff to pinkish buff⁶ on most media owing to the production of pionnotes on the surface of the slant. On beef-extract agar containing dextrose the pionnotes is shell pink to buff pink in young culture and avellaneous to wood brown in old culture. The surface of the slant becomes wrinkled. On corn meal the growth is cameo pink to Rosolane pink. On steamed rice the growth is fast and abundant but the color is variable. It ranges from pale ochraceous salmon or pale salmon color to salmon-buff. On agar media containing two per cent dextrose the growth is faster and the color is a little deeper than on those without this sugar. The growth in sterile plates is flat and three to six distinct zones may be observed on all agar media tested.

Taxonomy

After consulting the key to the sections of *Fusarium* given by Wollenweber, Sherbakoff, Reinking, Johann, and Bailey (1925) it is evident that

⁶The color of the culture was determined by comparing with Ridgway Color standards and color nomenclature (1912).

the Philippine onion bulb rot *Fusarium* belongs to the section Elegans. The shape and size of the 3-septate conidia⁷ are close to *Fusarium cepae* Hanz. emend. *Fusarium zonatum* (Sherb.) Wr. forma 1 and *Fusarium zonatum* (Sherb.) Wr. forma 2 Link and Bailey. The presence of zones in agar plates is the essential difference between the fungus under investigation and *F. cepae*. The fungus under study agrees with forma 1 and forma 2 of *F. zonatum* as to curvature of macroconidia but differs slightly as to size of the 3-septate conidia and shape of the basal cells. The two forms produce macroconidia which are predominately 3-septate. According to Link and Bailey (1926) the measurements of the 3-septate conidia of *F. zonatum* forma 1 are 37.1 by 3.8 μ and *F. zonatum* forma 2 38.5 by 3.7 μ . The Philippine onion *Fusarium* are 32.3 by 4.0 μ . This fungus differs from any of the two forms mentioned above by being a little shorter and a little broader. But Link and Bailey (1926) have separate measurements for small 3-septate conidia, the average of which are not included in the figures given above. If the average measurements of the small 3-septate conidia would be included the discrepancy in length is probably accounted for. These rather close identities of the Philippine onion bulb rot *Fusarium* with any of Link and Bailey's forms, together with its zonate character in agar plates, cause the writer to believe that the Philippine fungus is also *F. zonatum*.

The Philippine *Fusarium* seems to lie more closely to *F. zonatum* (Sherb.) Wr. forma 1 than to *F. zonatum* (Sherb.) Wr. forma 2 Link and Bailey. It differs materially from *F. zonatum* forma 2 by the absence of red color on steamed rice. It differs from *F. zonatum* forma 1 only in shade of color on steamed rice. On steamed rice the Philippine fungus is pale ochraceous salmon or pale salmon color to salmon-buff and *F. zonatum* forma 1 is cream white to salmon buff or salmon color. This slight difference in shade of color if it be regarded as a difference at all is not sufficient evidence to segregate the Philippine *Fusarium* from *F. zonatum* (Sherb.) Wr. forma 1. In this paper the fungus in question is considered as a more virulent type of *F. zonatum* (Sherb.) Wr. forma 1 because it is capable of infecting onion bulbs without wounds.

Proof of pathogenicity

Pot inoculation. Healthy bulbs of Singapore Red, Singapore White, and Bombay onions were soaked for 20 minutes in 1:1000 mercuric chloride solution. They were then washed with sterile water and planted in kerosene cans containing soil which had been autoclaved for two hours at 15-pounds' pressure.

⁷ The type of conidia primarily used by the writer in comparing the Philippine onion bulb rot *Fusarium* with other species of this genus is the 3-septate conidia as they form the normal type. According to Wollenweber, Sherbakoff, Reinking, Johann, and Bailey (1925) normal macroconidia form the basis for a natural classification.

Two methods of inoculation were used, one was by pouring spore-suspension around the bulb in each hill and the other by inserting the spores into a small wound cut out of the scale plate. Three cans were used in each inoculation. Two were inoculated and the third was used as control. The cans were placed outside of the laboratory where the sun could shine on them only in the morning and at noon.

The two methods of inoculation were equally effective. All the control cans showed 100 per cent germination. Symptoms of infection were shown 7 to 14 days after the foliage emerged from the soil. Inoculation of the bulbs through wounds was more fatal to the plants than by pouring spore-suspension around the bulb (plates I and II). Many of the bulbs which were inoculated through wounds failed to emerge, and microscopic examination of the decayed tissues showed the presence of mycelium and conidia of *Fusarium* much the same as those found in culture.

Yellowing from the tips and then the subsequent dying back of the leaves were the conspicuous symptoms (plate III). In many instances the leaves showed loss of stiffness without conspicuous yellowing. They bent and then they became yellow and soon dried out. Some of the plants whose foliage had dried out were pulled up and examined. Rotting of the bulbs similar to that described under "Symptoms" was observed. The mycelium was found in the decaying tissues. The fungus was recovered in the decaying tissues. The fungus was recovered in re-isolation from the bulb.

Field inoculation. Singapore Red and Singapore White were the varieties used in this inoculation. The experiment was started on February 14, 1927. The plots were watered every afternoon. Two plots three meters long and one meter wide were used for each variety. Onion bulbs which had been previously treated with 1:1000 mercuric chloride solution for 15 to 20 minutes were planted in each plot. They were planted in rows about 25 centimeters apart; 10 to 12 bulbs were placed in each row. One plot was inoculated by pouring the spore suspension around each hill. The other lot remained untreated. About 97 per cent of the bulbs in the treated and untreated plots germinated.

Ten days after the emergence, three plants of the inoculated Singapore Red and six of the Singapore White showed the first symptoms of infection. No plants in the control plots showed any symptom. Twenty days after the first observation about 85 per cent of the plants in inoculated plots died. Those that remained showed signs of infection. Most of the plants in the control plots exhibited symptoms of tip-burns owing to the intense heat of the sun. Some showed symptoms of yellowing similar to those caused by *Fusarium* but after close examination it was found that they were attacked by *Sclerotium rolfsii* originally present in the soil. The sclerotial bodies of this fungus were produced abundantly at the neck of the infected bulbs.

Within five weeks all of the plants inoculated died, while about 80 per cent of the control plants were still alive. Bacteria, nematodes, and maggots were found in the decaying tissues.

Cross inoculation using other bulb-producing plants. *Allium sativum* Linn., *Allium porum* Linn., and *Crinum asiaticum* Linn. were planted in pots and then inoculated through wounds and through soil with the Philippine onion *Fusarium*. No symptoms of *Fusarium* infection were noted in any of the plants.

Relation of soil moisture to the development of disease

An ordinary dry field soil consisting of clay loam was sifted and autoclaved for two hours at 15-pounds' pressure and then placed in 21 new pots of known weights. The holes in the bottom of the pots were closed and the inside surface coated with paraffin by heating in order to cover the minute pores of these earthen containers. The water-holding capacity of the soil was determined and was found to be 29 per cent of the weight of the dry soil. Selected bulbs of Singapore Red onion were sterilized with mercuric chloride (1:1000) for 20 minutes and then three were planted in each pot. Based on the water-holding capacity, the following moistures were used: 10 per cent, 30 per cent, 50 per cent, 70 per cent, 85 per cent, 95 per cent, and 100 per cent. In each moisture three pots were used, two were inoculated and the third remained as control. The loss of weight of the pots was restored every day by the addition of water.

After 10 days the young plants emerged except those in 10 per cent moisture where the soil was dry. In this moisture the plants emerged some days later.

Symptoms of infection were first noted in 30 per cent and 95 per cent moisture two weeks after emergence of the plants but only one plant in each showed the disease. Three weeks later these plants seemed to have general *Fusarium* infection (plate IV). The plants in 70 per cent showed the heaviest and most rapid infection followed by 50 per cent, 85 per cent, and 30 per cent, then by 95 per cent. The plants in 100 per cent were the last to show the symptoms of yellowing and dying-back of the leaves. No *Fusarium* infection was observed in 10 per cent moisture except that later the foliage showed tipburns.

The control plants were vigorous except those in 10 per cent and 30 per cent moisture where they were small and slow-growing. The poorest plants were produced in 10 per cent. The best plants were produced in 70 per cent, followed by those in 85 per cent, then by 50 per cent, 95 per cent, and 100 per cent, and then by 30 per cent. All the control plants were disease-free for two months after which they were affected with tipburns. The same behavior of growth was also shown by the plants in the inoculated lots; in the first few weeks only a few plants were infected.

From this limited trial it was found that the optimum soil-moisture requirement for the parasitism of the Philippine onion *Fusarium* lies between 50 per cent and 85 per cent of the water that the ordinary field soil in the College of Agriculture at Los Baños can hold. The plants grow in between 50 and 85 per cent. It seems evident that the optimum soil-moisture requirement for the growth of Singapore Red onion lies close to if not the same as the optimum for the parasitism of the *Fusarium* under investigation. Where the high moisture contents of the soil affect the growth of plants a little, the aggressiveness of the parasite is also correspondingly slightly reduced. Where dryness causes general stunting of the plants, the parasite can not produce the disease.

LIFE HISTORY OF THE PHILIPPINE ONION BULB ROT *FUSARIUM* IN RELATION TO PATHOGENESIS

Method of living over from season to season

In a very advanced stage of rotting, especially when desiccation is rapid, hyphal and conidial chlamydospores are produced. The onion refuse left in a *Fusarium* infected field may be loaded with spores. With the disintegration of the tissues they are liberated and are subsequently spread by certain natural agencies. The chlamydospores are provided with sufficiently thick walls with which they can resist adverse environment. When a favorable season comes, they germinate and start another infection in the field. In the Philippines, bulbs are used for propagation. The native planters do not pay much attention to bulb selection for the next planting season and in many instances they get them from *Fusarium* infected fields. The bulbs, although healthy in appearance, may have the mycelium in the tissues without causing any perceptible rotting, and soil particles that adhere to the bulbs may contain the spores. The mycelium in the tissues and the spores form sources of inocula for a subsequent storage or field infection. The writer believes that under certain conditions the Philippine onion *Fusarium* is capable of living as a saprophyte. Parasitism is established only when it comes in contact with its host under favorable weather and soil conditions.

Method of dissemination

The fungus is spread by the transportation of diseased sets from one place to another. The spores may also be carried by surface wash during heavy rains. Tools and implements also scatter the fungus. In Batangas, particularly in Lemery and neighboring towns, whirlwinds are frequent in the dry months of March and April. The whirlwind not only raises the dust in the fields several hundred feet high but transports it to distant places, and the writer believes that spores may be spread with the dust. It may perhaps be possible that insects breeding in the rotting tissues of the onion bulbs also spread the parasite.

Method of infection

Link and Bailey (1926) report that all the pathogenic species of onion *Fusarium* are wound parasites. Pot inoculations using wounded and unwounded onion bulbs showed that the Philippine parasite is capable of infecting both uninjured and injured onion bulbs. Wound inoculation, however, is more readily secured than by pouring spore suspension around the unwounded bulb. It is probable that the common method of infection in the field is through insect injuries in the bulb.

CONTROL

Sanitation

Where a slight infection has started in a small portion of the field it is advisable to pull up the plants for a meter around the point of infection. Then cover the infected area with inflammable materials and burn them to kill the causal fungus. This will prevent the spreading of the disease and infecting of the whole field. All of the trash and onion refuse should be burned after harvest.

Crop rotation

A long crop rotation in which no *Allium* species is planted should be practiced in an onion field infected with *Fusarium*. This will give no chance for the parasite to develop and multiply.

The following farm practices in relation to disease control are based on Walker's recommendations (1919):

Sorting onion bulbs

Bulbs which show signs of disease, insect injury or growth of fungi which do not even cause decay should be discarded. The growth of fungi which do not cause bulb rot weakens the onion bulb and makes it readily susceptible to rots.

Harvesting, curing, and storing

Harvesting should be done when the weather is dry and clear. High humidity favors the development of many onion diseases. Bruising and removing the tops down to the living tissues offer an avenue to an infection of bulb rot fungi.

It is necessary to lessen the moisture in the bulbs during their dormant stage by allowing them to "sweat", or cure. Moisture in the bulbs is conducive to the growth of fungi. Onions are allowed to cure by piling them in open sheds or in the field. If piled in the field temporary roofs for protection from rain should be built.

The onions should be stored in a clean dry house. Good ventilation should be provided. Since there is no very cool weather in the Philippines artificial heating is unnecessary.

SUMMARY

1. A bulb rot of onion caused by a species of *Fusarium* occurs in Lemery, Batangas, and probably also in other onion growing regions in the Philippines.

2. The symptoms are rapid yellowing or wilting of the leaves. The affected leaves dry out rapidly. When pulled up the bulbs show a semi-watery decay. The symptoms are identical with those given by Walker and Tims (1924) for the *Fusarium* bulb rot of onion in the northern Mississippi Valley.

3. The loss due to this disease in Lemery is about 40 to 60 per cent. The most important causal agent of onion bulb rot is a fungus belonging to the genus *Fusarium*.

4. The onion bulb rot *Fusarium* in the Philippines is somewhat similar to *Fusarium zonatum* (Sherb.) Wr. forma 1 and is considered by the writer as belonging to this variety.

5. This fungus shows more profuse growth on agar media containing dextrose than on those without this sugar.

6. Pot inoculations were readily secured through wounds and by pouring spore-suspension around the unwounded bulbs in the soil.

7. The disease develops in a variety of soil moisture content ranging from 30 per cent of the water-holding capacity of the soil to saturation, but the parasite is more virulent at 50 to 85 per cent than at any other soil moisture.

8. The disease is easily controlled by crop rotation and strict sanitary measures.

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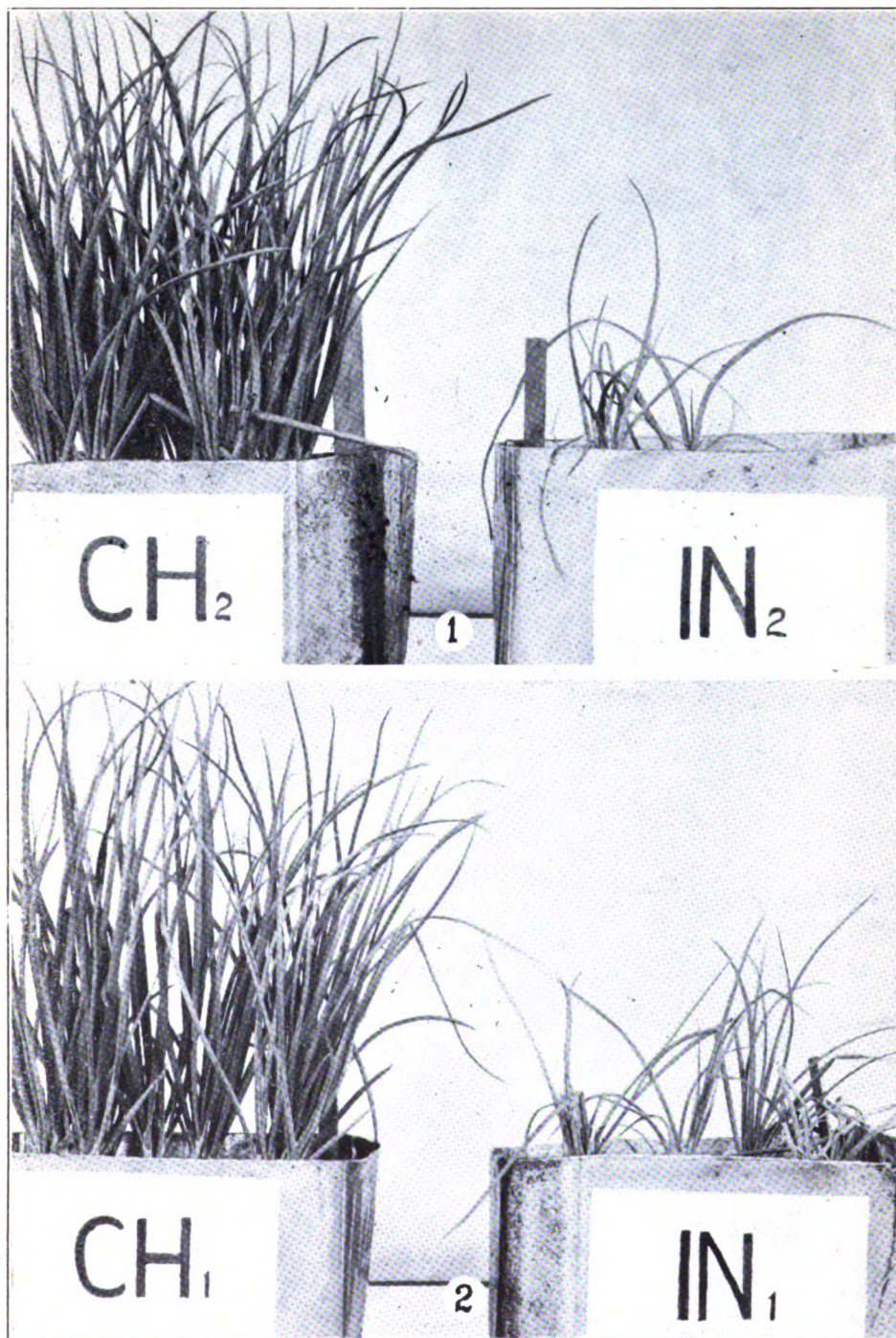


PLATE I

Fig. 1 and 2. One-month old Singapore White onion. The bulbs in IN_2 were inoculated through wounds and in IN_1 by pouring spore-suspension in each hill. The leaves of the affected plants show loss of turgidity or yellowing of leaves. The checks CH_2 and CH_1 show excellent development of the foliage.

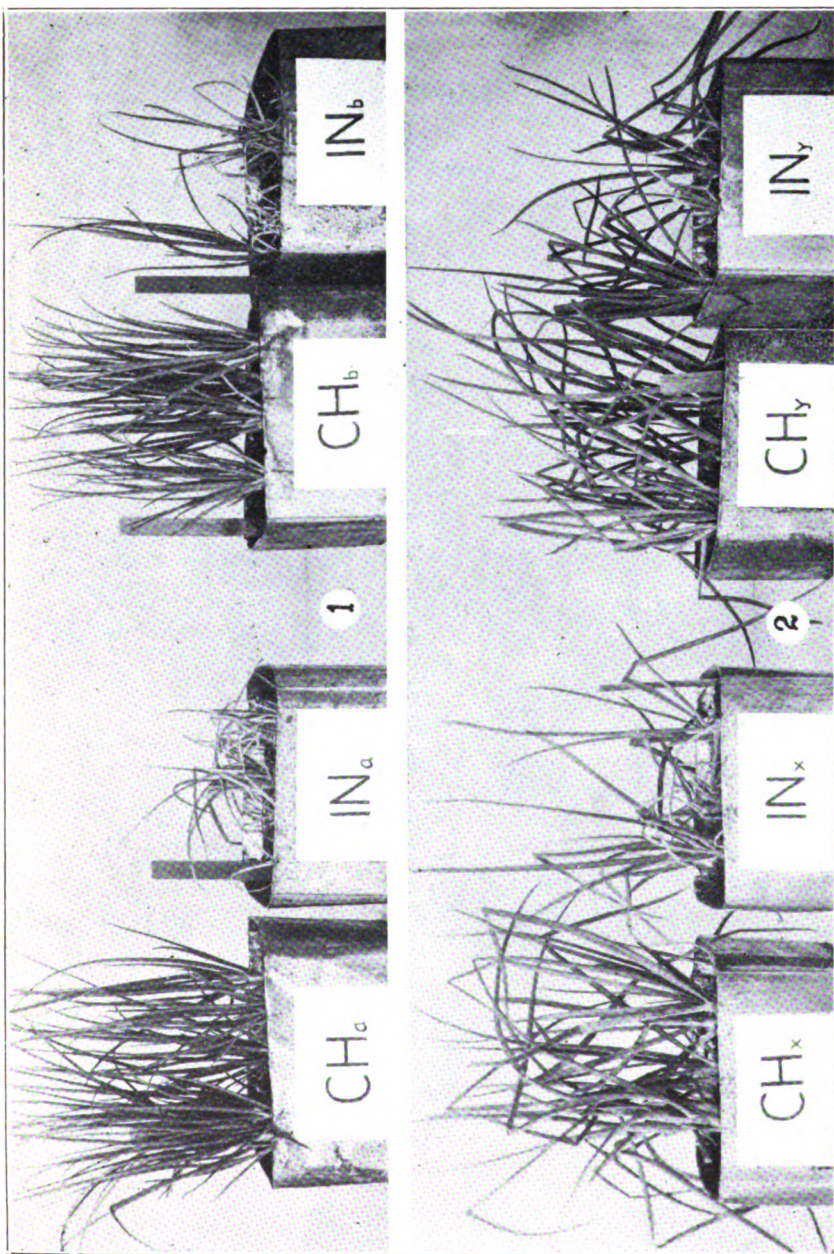


PLATE II

Fig. 1 and 2. One-month old Singapore Red onion (Fig. 1) and one month old Bombay onion (Fig. 2). Note the difference between plants inoculated through wound IN_a and IN_x and those inoculated by pouring spore-suspension around the bulbs in the soil IN_b and IN_y. The affected plants show withering and drying of the leaves. The control plants CH_a, CH_b, CH_x and CH_y look very healthy as though absolutely free from any disease; but two weeks after photograph was taken they showed tipburns.

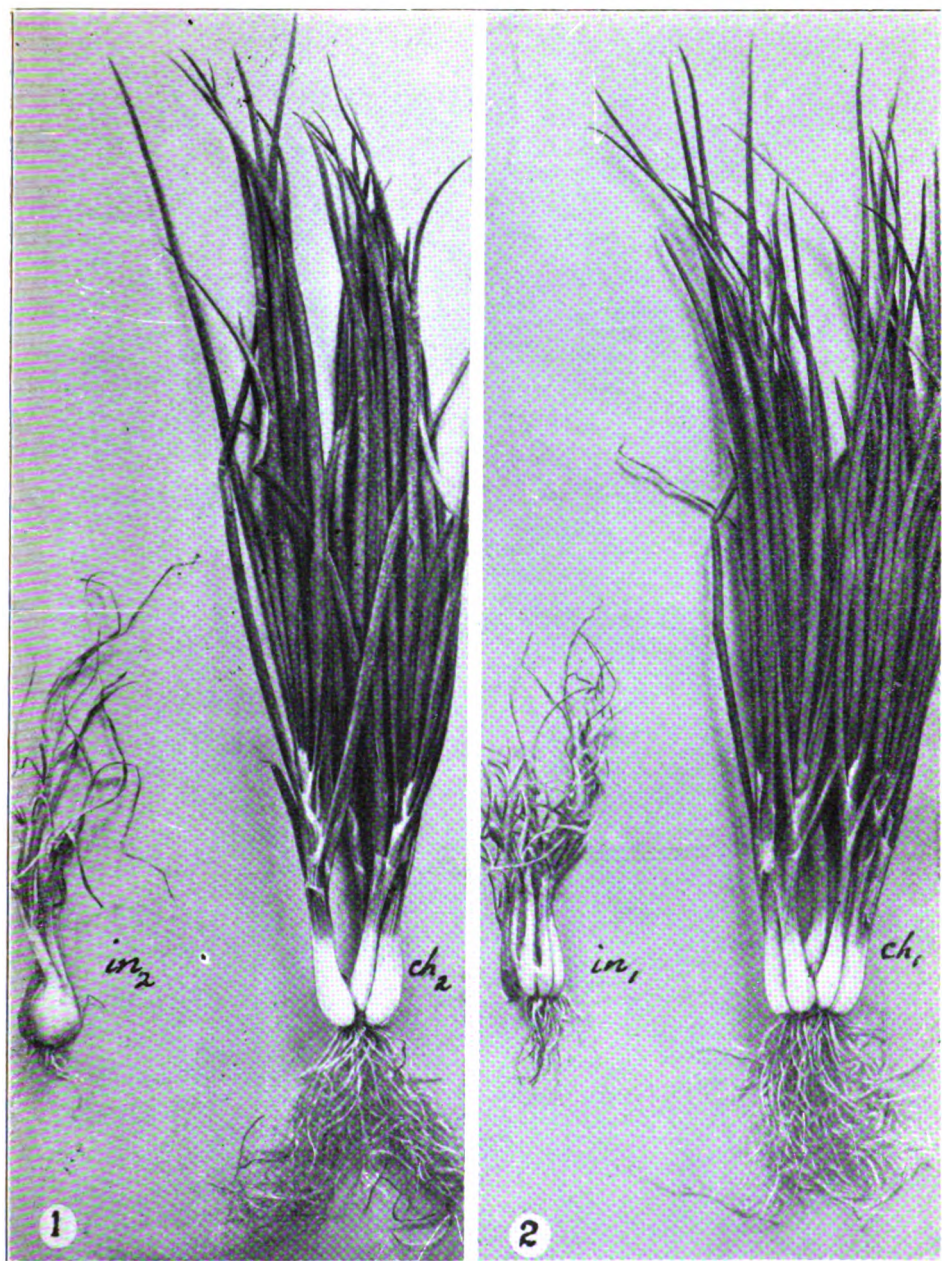
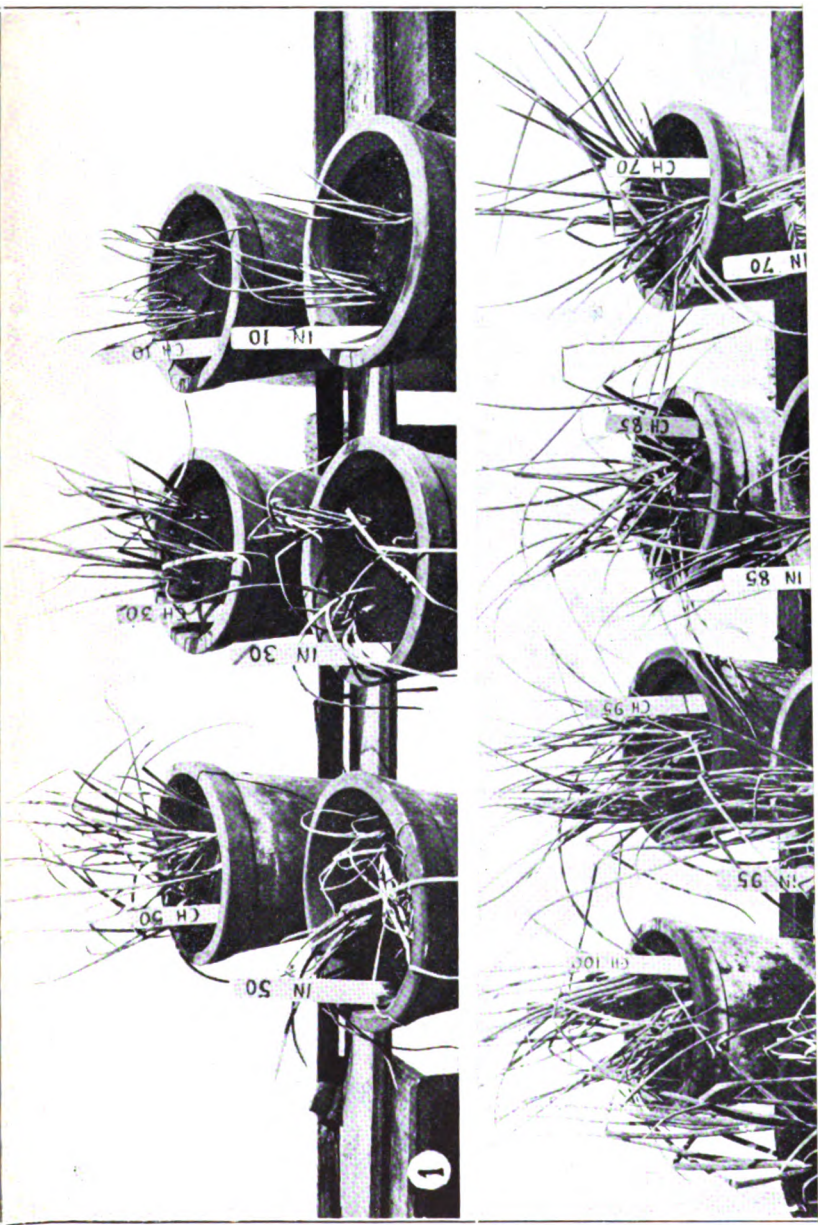


PLATE III

Fig. 1 and 2. Individual plants pulled up from each of the cans shown in plate I. Plant (IN₂) in figure 1 from bulb inoculated through wound and plant (IN₁) in figure 2 inoculated with spore-suspension show dried leaves, soft and rotted bulb scales and roots. The checks (CH₂) and (CH₁) show heavy foliage and well-developed roots.



NOTES ON YIELD OF SOME SPECIES OF COFFEE GROWN ON THE COLLEGE FARM¹

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Of the foreign species of coffee which have been introduced on the College Farm from time to time, only five so far have given fairly satisfactory results. These are *Coffea excelsa* Chev., *C. Quillou*, *C. robusta*, *C. canephora*, and *C. Liberica* (Hiern.) Bull. The failure of the other species is attributed to two main causes. Some of them were killed by the destructive fungus, *Hemileia vastatrix* B. et Br.; others were not adapted to the conditions of the Farm. The five successful species are to some extent susceptible to *Hemileia*, but in varying degrees. *Excelsa* and *Liberica* are able to withstand the disease owing to the thickness of their leaves. Infected leaves of these two species seldom fall prematurely from the stem. *Robusta*, *Quillou*, and *Canephora*, because of the delicate nature of their leaves, suffer more from the attack of the fungus.

In many respects *Liberica* is similar to *Excelsa*, the main difference being that the berries of the former are much larger than those of the latter but are much inferior in quality. One great objection to *Liberica* is the difficulty of preparing the berries for the market owing to the thickness of the pulp. It is also less productive than *Excelsa*.

Excelsa has many good qualities which are not found in *Robusta*, *Quillou*, and *Canephora*. The product is of superior quality. The plant is hardy in nature being able to stand drought and strong wind. In such field operations as weeding and cultivation it is not so exacting as the other species; it grows without much attention. Because of this characteristic this species has gained much favor with coffee planters with limited capital. Nearly all the newly established coffee plantations in Lipa, Batangas, are planted with *Excelsa*. It is becoming very popular among the coffee planters of Laguna also. It is reported to be in such great demand that the coffee nursery of the Bureau of Agriculture at Lipa can not supply the demand for seedlings. The College of Agriculture has been unable to meet the increasing requests for seedlings of this species.

In past years, owing to the destruction of the coffee rust, the coffee planters in Batangas lost interest in coffee culture. Many of them planted their coffee plantations to coconut and citrus. But five years ago upon

¹Experiment Station contribution No. 553. Received for publication August 10, 1928.

the introduction of Excelsa coffee the Batangas farmers again turned their attention to coffee growing. Now there are a considerable number of new coffee plantations being started. It is very likely that in ten years, Batangas may regain its former prestige as a leading coffee producing province.

As to the yielding ability of these coffees, our records in the College covering a three-year period from 1926 to 1928 show the following: Excelsa gave of fresh berries as the maximum yield a tree, 10.69 kilograms; Robusta, 6.79 kilograms; and Quillou, 6.43 kilograms. These figures are based upon records of 100 trees not included in this report. The average yield of fresh berries a tree in the three years' time was: Excelsa, 2.702 kilograms; Robusta, 1.702 kilograms; and Quillou, 1.645 kilograms. These figures show that the yielding ability of the individual tree of Excelsa is the greatest of the three. According to our determinations the percentage of clean beans based on the weight of green berries is as follows: Quillou, 25.06 per cent; Canephora, 25.0 per cent; Robusta, 23.2 per cent; Excelsa, 17.2 per cent; and Liberica, 10.1 per cent.

In the next two or three years we hope to make a more comprehensive report on the merits of these three species.

Canephora and Liberica have not been included in this determination because we have only a few plants of these varieties in our plantation. However, our records show that they are poor yielders. Also, no mention has been made of Arabica, as it does not thrive under our conditions no matter how much care is given the plants. If attacked by coffee rust the trees are defoliated before they come to bearing. It has been reported, however, that Arabica trees grow luxuriantly in the Mountain Province and in some parts of Mindanao with no sign of the rust.

A WORD OF COMMENT ON GORDON'S GRAVITY GATE¹

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WITH TWO TEXT FIGURES

In the gravity gate, what angle should the pivot piece make with the vertical in order to produce the greatest moment? This angle would then be the limiting angle, and while it may not be the most advisable angle, yet it should not be exceeded.

In order to simplify the solution of the problem, let the gate be opened so that its plane be perpendicular to the plane of the gate posts. (See fig. 1.)

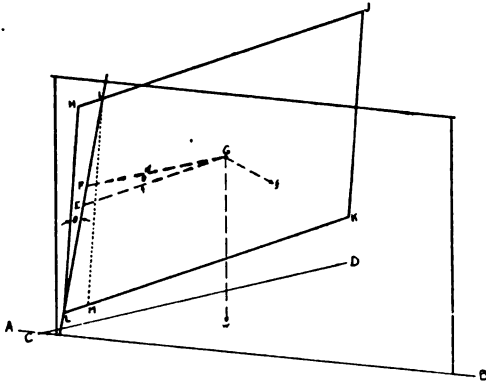


Fig. 1.—Diagram showing the Gordon gravity gate open with the forces acting to close it.

Let the intersection of the plane of the gate posts and the horizontal plane be AB , and that of the plane of the gate and the horizontal plane be CD . Hence the angle $BCD=90^\circ$. The gate makes an angle with the vertical plane through CD equal to Z , the angle which the pivot piece makes with the vertical, as this is really the plane angle of the dihedral formed by the gate and the vertical planes.

The weight w of the rectangular part $IJKM$ (which is the unbalanced weight) is perpendicular to the horizontal plane, and makes the angle Z with the plane of the gate. The effective force f which closes the gate is

¹Experiment Station contribution No. 554. Received for publication August 8, 1928.

Gordon, Alexander. 1928. A gravity gate, or a simple self-closing gate. *The Philippine Agriculturist* 17: 117-123.

the tangential component of w , and is therefore perpendicular to the plane of the gate; its angle with w , at the position of the gate taken, is $90^\circ - Z$.

In the figure, $HL = a$; $HJ = b$; $HI = x$; $FG = y$; $EG = \frac{b}{2}$.

We now have the following equations which lead to the solution of the problem:

$$(1) \quad x = a \tan Z;$$

$$(2) \quad y = \frac{b}{2} \cos Z;$$

$$(3) \quad w = k a (b - x),$$

k representing surface density;

$$(4) \quad f = w \sin Z;$$

$$(5) \quad M = f y.$$

The moment M can now be expressed in terms of Z and the constants. By actual substitution and simplification we get

$$(6) \quad M = \frac{kab}{2} \left(-\sin 2Z - a \sin 2Z \right).$$

Differentiating and simplifying we have

$$(7) \quad \frac{dM}{dZ} = \frac{kab}{2} (b \cos 2Z - a \sin 2Z),$$

and this is now put equal to 0 to get the maximum value of M .

We then get

$$(8) \quad \tan 2Z = \frac{b}{a}.$$

From this we see that the limiting angle, i. e. the angle giving the maximum moment, is one-half of the angle which the diagonal of the gate makes with the vertical. Fig. 2 shows this.

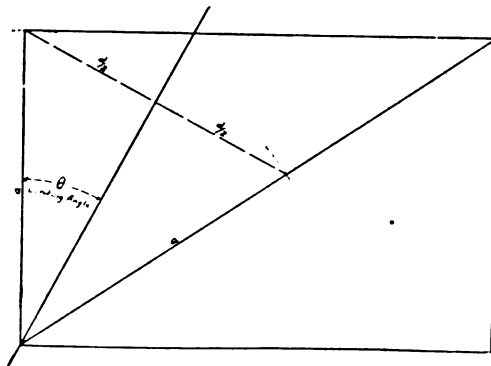


Fig. 2.—A diagram showing how to find the limiting angle for a Gordon gravity gate.

Possibly the most advisable angle would be about one-half or less than one-half of the limiting angle. Doctor Gordon gives 5° to 10° as the most advisable angle for ordinary gates. In the almost extreme case of the gate being twice as wide as it is high, this limiting angle is about 30° , and the angle he advises is still good; his experiments gave him satisfactory speed in and satisfactory force at closing using an angle of 10° , or $\frac{1}{3}$ of the limiting angle for such a gate. With a barn door twice as high as it is wide the limiting angle is about 14° ; and following his fraction of $\frac{1}{3}$, this would come to about 5° . According to Doctor Gordon, these were some of his reasons for adopting 5° and 10° as limits.

ABSTRACT¹

Corn production as affected by some common manures.

MARCELO B. PEÑA. (*Thesis presented for graduation, 1928, from the College of Agriculture No. 271; Experiment Station contribution No. 555*).—In this investigation the author experimented on: (1) the effect of Complete fertilizer (Big Crop 10-6-2) on the production of corn; (2) the effect of horse manure; (3) the effect of lime and wood ash; (4) the effect of cowpeas as green manure and (5) the effect of soybean as green manure. The work was conducted in the Department of Agronomy, College of Agriculture from 1926 to 1928. Baluga and Calauan Yellow Flint corn were used as seed. The experiment started with lot A which was divided into three plots, the first was planted to cowpeas, the second to soybean, and the third which was not treated served as control. When in full bloom the legumes were plowed under and the three plots were planted to Calauan Yellow Flint corn. Lot B was divided into four plots, each 60 by 28 meters; the four plots, numbered 1 to 4, were divided crosswise into two and the corresponding halves were numbered 1₂, 2₂, 3₂, and 4₂, respectively. The four subplots were treated with lime at the rate of 1000 kilograms to the hectare; the four original plots were not treated. Horse manure at the rate of 5 tons to the hectare was put on plots 1 and 1₂, Big crop 10-6-2 at the rate of 500 kilograms to the hectare on plots 3 and 3₂, and wood ash at the rate of 500 kilograms to the hectare on plots 4 and 4₂. Plots 2 and 2₂ were not treated. Lot C was prepared and treated as lot B with the exception that lot B was planted to Calauan Yellow Flint corn and lot C to Baluga Yellow Flint. The distance used each way was one meter between hills.

The experiment gave the following results: For three plantings, plot 1 of lot A gave an average yield of 293.02 kilograms of husked ears more than plot 2, and 603.42 kilograms more than the control; plot 2 gave an average yield of 310.29 kilograms more than the control. Cowpeas as green manure, therefore, proved better than soybean. Plots 1 of both lots B and C produced less than the control, while plots 1₂ of both lots gave an increase in yield in three plantings over the control. The results obtained in these plots were not very conclusive. Plot 4 of lot B gave an average yield of 165 kilograms more than the control, while plot 4₂ gave an increase in yield over the control in one out of three plantings. Plots 3 of lots B and C gave a higher average yield than plots 3₂ of the same lots. The use of fertilizer did not prove profitable. The use of lime alone did not prove productive; the use of wood ash with lime proved better than when used without lime.

¹ Abstract prepared as part of the required work in English 6, College of Agriculture.

The author observed that more diseased ears were found among the plants that matured early than among those that matured late. In lot B, both plots 4 and 4₂ gave a very high yield of marketable corn. Plots 2 and 2₂ gave the same quality of produce. The same quality of ears was obtained in plots 4 and 4₂, plots 2 and 2₂ in lot B; plots 3 and 3₂ in lot C; and the cowpea plot of lot A.

—Abstract by Felix N. Camba.

NOTE: "PREPARATION OF SCIENTIFIC AND TECHNICAL PAPERS"

Thoughtful critical comment is always of interest and usually valuable. The following which appears under "Notes on Books" in the May number of *Journal of the Royal Society of Arts* is of special value as the written output from this College is largely scientific and the book is our guide.

PREPARATION OF SCIENTIFIC AND TECHNICAL PAPERS. By Sam F. Trelease, Associate Professor of Botany in Columbia University, and Emma Sarepta Yule, Head of Department of English in the College of Agriculture of the University of the Philippines. London: Baillière, Tindall and Cox. 7s net.

It is not difficult to see that the task of a scientific writer is threefold; he must amass a collection of relevant material, by experiment, by reference to previous publications, and by abstract thought; he must select from this mass, and arrange his selection in such a way as to convey the desired impression to the reader; and, finally, he must produce such a manuscript as will give in unmistakable terms the necessary instructions to the printer.

All these aspects of the writer's problem are considered in this little hand-book, though it has naturally not been possible to include very much under the first of the three headings. The authors have had a wide experience in the reading of students' manuscripts, and all their suggestions are worthy of consideration, though on many points it is only to be expected that individual opinions will vary.

It is pointed out very justly that, while the printer cannot be asked to correct any kind of actual error, scientific authors have nevertheless a right to assume that their publisher will employ compositors with some special skill in setting up technical matter.

Many cases occur, in which it is not easy to fix the relative responsibilities of author and compositor. It is unfortunate, for example, that the first numeral is denoted in typescript by the twelfth letter of the alphabet, so that it is possible for a compositor to set up wrongly the chemical symbol of Cl for the element chlorine; but not every chemical writer would agree that it is his duty, as the present authors maintain, to make his typescript in such a manner as to make this error impossible.

Again, it is a little insufficient to remark with reference to algebraic symbols and equations, that these "should be italicized", having just previously explained the usual convention for italics. Unfortunately this convention, of a horizontal line under the letters, is required in mathematics for quite different purposes; and it is both obvious and notorious that for mathematical work there must be an *ad hoc* understanding between author and compositor if complete chaos is to be avoided.

On the whole, however, the advice given is sound and clear, and the book deserves the attention of all who have occasion to publish technical papers.

EXTENSION NOTES

Prepared by Moisés M. Kalaw under the supervision of Professor Inocencio Elayda

More About Pioneering Work

In the September Extension Notes emphasis was laid upon the need for some initial capital for the development of a piece of public land. This emphasis may have raised a question in the mind of some young man interested in pioneering as to whether he dared venture without capital or with very little. Of course this depends upon circumstances, and upon individual or collective initiative.

There are many instances where tracts of public land have been developed with little or no capital at the start. Poor men with strong determination to become independent landowners have taken chances and occupied a piece of public land through a homestead entry or through a caifgin or residence permit. Where feasible, they walked all or part of the way from their home to the new place because they could not pay for transportation. Or they earned the money for the transportation on the way by stopping over here and there and working a few days for wages. Upon reaching their destination they built a shack on their new land or lived with the nearest settler while clearing a portion of the land and putting up a shelter of their own. Not having ready money for daily needs they found jobs to eke out a living while working sporadically on their homesteads and waiting for their harvest.

When better acquainted with their new surroundings they gradually gave up their wage-earning jobs and turned to hunting, fishing, logging or gathering forest minor products that could be readily sold. Thus, in time, with the land producing more and more farm products and with some additional income they became independent. More time was given to farm work and some help hired and the clearing and cultivation extended. Finally, after a period of five years when they had brought under cultivation most of the area of their land grant they obtained the title to their claim.

Generally speaking this is what we call farming without initial capital or government aid. But it is obvious that there was some sort of initial capital and some earned right along in a haphazard way and immediately put to use on the land.

Then there are men desirous of owning land who take a salaried job in cities or towns with the idea of accumulating some capital for a future farm business. When they have saved enough to cover their initial expenses—transportation to get to the new place and beginning the breaking of the

new land—they start their venture. The trouble with this plan is that many find the accumulation of capital so slow they become discouraged and the lure of sure and pleasant positions is greater than that of pioneer farming. Consequently, they abandon the idea of becoming landowners or buy an established plantation. Thus they increase the number of *absentee landlords* instead of *dirt farmers*.

Although these three types of endeavor are all in the nature of constructive undertakings, one important difference must be borne in mind: That the occupation and development of a piece of public land will mean an addition and substantial increase in the permanent assets of the country while the town job does not.

A Valuable Aid to Homesteaders

One of the hardest tasks of a homesteader in breaking his land is the cutting down of big trees, as the public land is usually covered with lumber trees. Some of the land available for homesteads is under the concession of lumber companies which are entitled to the commercial lumber included in their concession. In this way the land which would have been a virgin forest becomes very easily cultivable. If applicants for homesteads keep their eye on such lands, as is the practice in the Camarines provinces, they will be saving a great expense and effort. A homestead on these concessions can be easily reduced to a clean farm, if the homesteader immediately follows the lumbering operations with the usual process of clearing, that is, cutting the remaining vegetation, drying and burning the trash, letting the big trunks and stumps rot.

Information as to these concessions can be secured from the Bureau of Forestry. Prospective homesteaders should try to inquire from the proper Government authorities about the availability of this kind of land.

But if the place applied for under a lumber concession is not to be logged right away and the homesteader wants to enter the land without delay, he should enter into contract with the lumber concessioner to allow him to log the timber trees for a reasonable consideration. An advantage here is an income to enable him to tide over the period of non-production of newly opened land.

Caution to Applicants for Public Land

There have been cases of homesteads adjudicated to applicants through issuance of Torrens titles which were revoked by the Insular Supreme Court in recognition of the preferential right of a counter claim brought in to the Court before or after the applications were entered. These cases are tragedy, for the revoking of the title means that the homesteader loses the results of five years of hard work and self-denial. However, there seems no help for the situation. The Bureau of Lands assumes no responsibility for the land granted the applicants being free from encumbrances and entanglements.

This is the applicant's own lookout. The entry of any piece of public land by private individuals or concerns and even of any tract of public land reserved by the government for public purposes by proclamation of the Governor General does not in the least preclude private rights established to any portion or the whole of the land in question previous to the entry. In fact in the latest proclamations of the Governor General setting aside public land for government reserves or declaring it open for agricultural purposes, there is a specific proviso to the effect that legitimate private claims are not in the least jeopardized by the declaration.

The College Extension Service takes interest in this matter for the sake of small farmers who go out and homestead public land under conditions described in these "Notes". This service advises, indeed, urges those applying for a piece of public land to make absolutely sure that the land they apply for is free from any counter claim. If at any time this adverse claim is discovered, the thing to do is to settle the matter with the claimant in a friendly way and not in Court. This will avoid delay and waste of money, energy and time and sometimes loss of land.

EXCHANGE NOTES

I am a junior farmer, 14 years old, in the seventh grade in school. I raised pigs for market in 1927. I fattened and sold \$200 worth. The first pig I owned I bought with \$5 I got for a dog. He was a sure enough runt. That's why I got him for \$5. He looked the part, was shaggy and had a long nose and back. My mother always had taught me to try and see something good in every animal that lives. I looked carefully at my own pig. A great lump of disappointment rose in my throat, but I thought, "he has bright, kind eyes, and here's where I begin feeding him five good meals a day."

His nose grew shorter, his hams filled in, giving his back the needed fullness. He grew by leaps and bounds. When he was 6 months old he politely tipped the scales at 250 pounds. I sold him on foot for 18 cents a pound, and got my first \$45. I deposited \$40 in the bank. With the extra \$5 and \$2 added, made by selling tomato plants, I purchased a second pig. He grew as did the first one, and in 6½ months he weighed 258 pounds. I sold him dressed for 18 cents a pound. I added this to my bank account. I sold \$65 worth of chickens I had raised and made \$7 by selling tomato plants.

I had 24 laying hens in 1927. I deposited in the bank \$200. It's there yet and this year I expect to add to it. My dad is a real fellow. My pig is not his hog, my calf is not his cow, my coit is not his horse, my bank account is not his bank account. We are pals. I have got acquainted with

him. We are partners in this farming business. I love the farm. I long to be a man. To every boy who reads my letter I will say: Feed your pigs well, and above everything else get acquainted with your father.

—JOHN RENO, *Capper's Farmer*.

Ultra-violet rays, used to prevent the bone disease, rickets, in young children and animals by raising the calcium and phosphorus content of the blood, have a parallel effect on plants. This is indicated by the results of experiments by Herbert C. Beeskow, a graduate student at the University of Chicago.

Mr. Beeskow grew groups of soy bean plants in solutions of known mineral composition. He subjected different groups to ultra-violet radiation for varying periods of time, keeping other groups away from the rays as "controls." Then he dried the plants and analyzed them for calcium and phosphorus. In each case it was found that the irradiated plants had noticeable higher contents of these important minerals than the corresponding unrayed controls.

The effects of irradiation with ultra-violet light were not all beneficial to the plants. Soy beans grown in the greenhouse and subjected to direct ultra-violet raying for as short a period as one minute every other day showed a distinct reddening in the parts of the stem and leaves struck by the rays. In cases where the under side of the leaves was exposed to the rays the reddening action was much more in evidence.

Plants grown in darkness and subjected to the rays showed this red color much more distinctly than plants grown in daylight and permitted to become normally green. Heavy overdoses of the rays simply killed the plants.

—*Science*.

Vitamine B is really triplets. The well known food factor has been separated into three parts, each of which has different effects, according to a report by Charles H. Hunt of the Ohio agricultural station, to appear shortly in *Science*.

Two of the vitamins when fed together cause a moderate rate of growth. When fed alone each of these two causes only a slight increase in growth for a short time. The third, found in residue from which the other two had first been separated, causes when used alone only slight growth for a short period, after which there is a decline. When this vitamin is added to the two others the excellent growth associated with the original vitamin B results.

Further tests showed that this third vitamin has all the characteristics of a vitamin in addition to being able to stimulate the other two so that they cause greater growth than when used alone.

—*California Cultivator*.

Can the stock permanently affect the true heredity characters of the graft? The affirmative answer has often been given. But the results of careful experiment entirely rule out the possibility. The developing graft, which becomes the "top" of the tree, is intimately affected by the kind of stock on which it is placed. The effect, however, is purely physiological. Whatever peculiar specific influence the stock exercises on the graft is due to its exercising root functions for the graft. The graft is not permanently affected. Its true hereditary characters remain unaltered, and if shoots from it were grown on their own roots, they would grow true to the type to which the original graft belonged.—F. L. ENGLENDOW, in "Agricultural Research in 1926."

—*The Agricultural Gazette of N. S. W.*

One of the functions of a farm paper is to bring these [new] methods to the attention to the rank and file of farmers. A speaker from the [Agricultural] college can talk to hundreds. A bulletin will be read by several thousands. But the great majority of farmers—more than 150,000 of them in Illinois in the case of PRAIRIE FARMER—depend on their farm paper to bring them this information.

—*The Prairie Farmer* (Illinois).

COLLEGE AND ALUMNI NOTES

Doctor Rebecca Parish, Director of Mary Johnston Hospital, Manila, was the speaker at the third student body convocation. Doctor Parish returned recently from a year's furlough, several months of which she spent in southern and western Asia and in Europe. In her address she took her audience with her from Singapore to Rome accenting not the scenery but the people, especially the trend or awakening in education. Doctor Parish etches her picture clearly and leaves no question in the minds of the audience as to the purpose of the picture.

Dr. C. J. Humphrey, Mycologist, Bureau of Science, was a Campus visitor on August 16 and 17. He went over the higher basidiomycetes in the Baker Herbarium of the Department of Plant Pathology. Doctor Humphrey is an incessant worker, with great interest in Plant Pathology. He talked over with Dr. G. O. Ocfemia of the Department of Plant Pathology the future of Plant Pathology in the Philippines and the control of some of the diseases of our important crops.

Mr. Epifanio Enerva of the class 1924 was a visitor in the College on August 18. Mr. Enerva is now farming in Alaminos, Pangasinan. From graduation up to last year, Mr. Enerva was connected with the San Carlos Agricultural School as teacher. He resigned in June, 1927, to operate his own farm which consists of about 104 hectares. He bought recently 21 more hectares to add to his present holdings. He came to Manila to confer with the Bureau of Lands officials. Being so near he came out to the College to visit old friends and old scenes.

The Los Baños Biological Club held its thirty-seventh scientific program in the Auditorium of the College of Agriculture on September 6, 1928.

The following papers were read and discussed:

"The fisheries of Laguna de Bay with special reference to the problem of conservation and protection", by Dr. Deogracias Villadolid.

"Is the carabao susceptible to tuberculosis?" by Dr A. K. Gomez.

"A report on the 'many-eyed' character of sugar cane", by Mr. Toribio Mercado.

The Mimics presented "Daughters For Sale" by Carlos P. Romulo on the evening of September 22. The characters in the play were interpreted by the following members:

Cast in order of appearance

Don Pelayo	-	-	-	-	-	Agapito Muyargas
Gregorio, the barber	-	-	-	-	-	Primo Manuel
Rosario, daughter of Don Pelayo	-	-	-	-	-	Soledad Marfori
Maria, daughter of Don Palayo	-	-	-	-	-	Candilaria Dionisio
Amparo, daughter of Don Pelayo	-	-	-	-	-	Emerciana Lorenzo
Don Juan, a rich land owner	-	-	-	-	-	Francisco Franada
Aurelio, School of Commerce graduate	-	-	-	-	-	Domingo Tugade
Mariano, Chinese tienda keeper	-	-	-	-	-	Lorcto Valera
Miguel, graduate from College of Agriculture	-	-	-	-	-	Filemon Español

The play was directed by Miss Anna F. Cole of the Department of English. The production showed careful and intelligent study and painstaking rehearsals. The Mimics is to be congratulated.

A college atmosphere was created by the playing of our college songs by the orchestra before the curtain rose and between the acts and the spontaneous singing of the songs by the audience. At the last curtain the lively Varsity March gave a final college touch to an excellent student performance.

It was most fitting that this, the opening night for the Mimics this year, should be celebrated by the "first appearance" of the drop curtain, the first in the Auditorium. This curtain was a project started three years ago by Miss Wilson, then director of the Mimics.

The curtain was painted by the College artist, Mr. Villaluz, most pleasingly and artistically. Mr. Villaluz used for his theme in scene on the curtain the view as seen from the Administration Building.

The audience expressed appreciation of the curtain by "three cheers for Villaluz", led by Antonio Flores, College Yell Leader.

THE MAIN BUSINESS OF SCIENCE

To the thinking man it is almost self-evident that the finest fruits of Art or Science are the products of leisure. They ripen slowly and when forced lose something in flavor and quality. It is well for us to bear this in mind as we strive to direct Science into ways of social service—to make it “practical”, “economic.” There is always a danger—a very slight danger perhaps but nevertheless a very real danger—that in endeavoring to make it immediately valuable we may make it ultimately valueless. We may produce a large fruit crop that will appease a present hunger, but that will give little nourishment. This is no argument against any “economic” science, nor even against Science economically directed. It is a caution to those who may be tempted to make Science completely subservient to Economics.

Obviously the first business of a man is to live; but it is not his sole nor greatest business. He must live in some manner conformable with Truth. Similarly as regards Science. Her one business is to serve human necessity; for if she do not this then there is no ethical justification for her whatever. But her other and greater business is the seeking of Truth for its own sake. With such a two-fold understanding we admit at once the possibility of a conflict of interests in both the human and scientific worlds. Just as a man, who wishes to live as he should, must be ready to sacrifice his life; so Science, that would be of the greatest service, must sometimes give the search for Truth precedence over the economic problem of the moment.

There is no need to stress the point. As far as Science is concerned, conflict between the ideal and the practical is imminent only if we insist upon reducing scientific study to a purely utilitarian basis. In that event freedom disappears and with it the opportunity for any lasting or finally valuable contribution.

So much for generalities. The point of the argument is this: that those who support science—the government, the corporations, the public—should recognize the need of purely scientific research and provide for it generously. Science should be subsidized as Science, not merely as an adjunct to agriculture, industry, commerce or health; and the scientist should be assured of sufficient leisure for the most far-reaching investigations.

He on his part must not forget his obligation as a public servant; but in his endeavor to serve he should also be careful not to confound service with servitude.”—CARL HEINRICH.

TESTIMONY

My garden bears testimony to divinity;
 I sow the seed, itself a mystery;
 Invoke the graces of the sun;
 Implore the ministry
 Of the rain; and yet, when this is done,
 It is God
 Who thrusts up
 Through the imprisoning clod
 Miracles of emerald leaf and radiant bloom,
 Fashioned of fabrics from a heavenly loom.
 Surely none but God can,
 Within a seed's pin-point of space,
 Pack a blue-print of the Cosmo's swaying grace,
 Or, from a dry brown root release
 The Phlox in all its white peace.
 He hangs the Rose upon the thorn,
 And lifts the Lily's Samite cup
 Brim with the dewy nectar of the morn.
 It is God alone, knowing infinitely,
 May be so prodigal of beauty
 That he gives to the errant winds the poppy
 And the Rose, or yields to Winter's Devastating hold
 Autumn's arabesques of flame and gold.

EVA MOAD TURNER.

—*Gardeners' Chronicle of America.*

THE TRAGEDY OF THE UNFIT

The selection of those who shall be admitted to the privilege of a fine education at much less than cost is fundamentally a study in social justice. It involves the rights of faculty members who are investing their own lives in the next generation, the rights of generous philanthropists and of hard-working tax-payers, the rights of those who will finish as well as those who will withdraw; finally, the rights of parents and students who regard college as final opportunity to prepare for lives of service, as well as those who consider a college education a delightful experience made up of some study, much play, interesting associations, multicolored activities. . . . Of the class of 1931 who will begin work in September, there will be three groups of students: (1) those who will succeed and ultimately receive diplomas; (2) those whom personal considerations will face to withdraw; (3) those who cannot or will not make good.—MORTON SNYDER, in *Progressive Education*.

—*What The Colleges Are Doing.*

THIRD LIST OF CYANOPHORIC PLANTS OF MAQUILING REGION¹

FERNANDO DE PERALTA
Of the Department of Plant Physiology

This brief report on the determination of plants of the Maquiling region that contain prussic acid (or hydrocyanic acid) is a continuation of similar studies reported by Herbert (1922) and Juliano (1923). A large number of plants were tested for the presence of prussic acid but only the plants that were found to contain the acid are here reported.

The method employed to detect the prussic acid in the plants was similar to that employed by Herbert. That is, the material to be tested was cut into small pieces. From the cut sections a 10-gram sample was taken and put into a small bottle containing 100 cubic centimeters of sodium picrate solution to which a little chloroform had been added. The bottle was then stoppered and set aside for an hour. If prussic acid was present the solution became red; if no prussic acid was present the solution remained yellow. The scientific and vernacular names of the plants used were checked with *An Enumeration of Philippine Flowering Plants* by E. D. Merrill, (1923-1926) and are listed below according to the alphabetical arrangement of the family names:

ANACARDIACEAE

Semecarpus cuneiformis (Ligas): Positive in roots and bark; trace in leaves and wood parenchyma.

Spondias cytherea: Trace in roots, bark, and leaves.

Spondias pinnata: Positive in leaves; trace in roots and bark.

ANONACEAE

Anona squamosa (Ates): Positive in leaves, bark, and roots; trace in wood parenchyma; negative in the pulp; slight in the seeds.

BOMBACACEAE

Bombax ceiba (Buboy-gubat): Positive in roots, stem, and leaves.

BORAGINACEAE

Cordia myxa (Anonang): Positive in roots, fruit, bark, and leaves; trace in wood parenchyma.

Heliotropium indicum (Hinlaloyon): Positive in leaves, bark, flowers, fruit, and roots; negative in wood parenchyma.

EUPHORBIACEAE

Aleurites moluccana (Lumbang): Positive in stem and fruit; trace in leaves; negative in roots.

¹Experiment Station contribution No. 557. Received for publication, August 24, 1928.

- A. trisperma* (Baguilumbang): Positive in roots and bark; trace in leaves, flowers, pulp of fruit and wood parenchyma.
Euphorbia trigona (Sorog-sorog): Positive in leaves, bark, roots, and stem.
Jatropha curcas (Tuba): Positive in leaves, bark, roots, and fruit; trace in wood parenchyma.
J. multifida (Maná): Positive in roots, stem, and leaves.
Mallotus philippensis (Banato): Positive in roots, stem, and leaves.
M. ricinoides: Positive in roots, bark, and leaves; trace in wood parenchyma.
Ricinus communis (Taňgan-taňgan): Positive in roots, bark, and leaves; trace in wood parenchyma.

LABIATAE

- Ocimum basilicum* (Solasi): Positive in leaves, bark, and roots.

LECYTHIDACEAE

- Gustavia gracillima*: Positive in roots, bark, leaves, fruit; trace in wood parenchyma.

LEGUMINOSAE

- Cassia fistula*: Positive in roots, stem, and leaves.

LYTHRACEAE

- Lagerstroemia speciosa* (Banaba): Positive in roots, stem, and leaves.

MALVACEAE

- Sida acuta* (Ualisualisan): Positive in leaves, bark, and roots.

MORACEAE

- Artocarpus communis* (Rimas): Positive in leaves, stem, and roots; negative in fruit.
A. integra Merr. (Nanca): Positive in stem, leaves, fruit, and flowers.
Castilloa elastica (Rubber tree): Positive in bark, roots, leaves, and fruit.
Ficus cumingii (Isis na puti): Positive in stem and roots.
F. hauili (Hauili): Positive in roots, stem, and leaves.
F. nota (Tibig): Positive in stem, roots, leaves, fruit, and flowers.
F. odorata (Paquiling): Positive in stem, roots, and leaves.
F. pseudopalma (Niog-niogan): Positive in stem and roots.
F. stipulosa (Balete): Positive in stem, roots, and leaves.
F. ulmifolia (Isis, Asis): Positive in bark, roots, and leaves.
Morus alba (Mulberry): Positive in stem, roots, and leaves.

MYRTACEAE

- Eugenia jambos* (Tampoi): Positive in roots, stem, and leaves.

OXALIDACEAE

- Averrhoa carambola* (Balimbing): Positive in leaves, roots, and stem.

PASSIFLORACEAE

- Passiflora edulis* (Pasion): Positive in roots and stem; trace in leaves.

SAPINDACEAE

- Guioa perrottetii* (Salab): Positive in roots, stem, and leaves.

STERCULIACEAE

- Kleinhovia hospita* (Tanag): Positive in roots and leaves; trace in stem.
Sterculia foetida (Calumpang): Positive in roots, stem, and leaves.

TILIACEAE

- Columbia serratifolia* (Anilao): Positive in leaves and roots; trace in stem.
Corchorus capsularis (Pasio): Trace in bark; negative in leaves and roots.

Grewia multiflora (Danglin): Positive in leaves and roots; trace in stem.

Triumfetta bartramia (Calot-calotan): Positive in roots, leaves, and stem.

VERBENACEAE

Premna odorata (Alagao): Positive in leaves, stem, roots, and fruit.

P. subscandens (Alagao-baguing): Positive in leaves, stem, and roots; trace in flower and fruit.

VITACEAE

Cissus trifolia (Calit-calit): Positive in stem, leaves, and roots; trace in flower and fruit.

Tetrastigma harmandii (Ayo): Positive in leaves; trace in stem.

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THE BEHAVIOR OF THE ANTIMONY ELECTRODE IN BUFFERED AND UNBUFFERED SOLUTIONS¹

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WITH TWO CHARTS

INTRODUCTION

For several years efforts have been made in this laboratory to find a suitable non-gas electrode for determining in a continuous manner, the hydrogen-ion concentration of different solutions. The main considerations which determine the suitability of an electrode for pH determination are: (1) its constant behavior at a given pH regardless of the presence of other substances such as proteins, salts, "poisons", etc.; (2) the quick response it gives after being placed in the solution; (3) the wide range of pH at which it can be used; (4) the ease with which it can be prepared and its cheapness; and (5) its sturdiness together with the very little attention required for its proper working.

The object of the work here reported was to test the behavior of the antimony electrode in buffer solutions, in partially neutralized solutions of acid and base, in soil solutions and in sugar solutions, with a view to determining the constants E_o and a of the equation $E_{obs} = E_o + a \text{ pH}$, and the possibility of this electrode for controlling sugar juice clarification.

The antimony electrode was first used by Uhl and Kestranek (1923) as a method for determining the end point of neutralization reactions. Besides showing that a sharp potential drop was obtained at the end point, they found that the presence of chlorides and ammonium salts did not affect the determination of this point. Later, Kolthoff and Hartong (1925) extended the use of the antimony electrode to the determination of hydrogen-ion concentration of different buffer solutions, and they found that while for acid media, a definite linear relation obtained between the potential and the hydrogen-ion concentration, this same relationship did not obtain in alkaline media. According to them at 14°C. and between pH 1 to 5, the relation $E = 0.0415 + 0.0485 \text{ pH}$ held, while above pH 9 the relation was $E = 0.009 + 0.0536 \text{ pH}$.

Franke and Willaman (1928) used the same electrode for measurement of hydrogen-ion concentration in the control of pulp and paper manufacture, and from a determination of the potentials at different hydrogen-ion con-

¹Experiment Station contribution No. 558. Received for publication October 2, 1928.

centrations of buffer solutions, they found the relation $E = 0.050 + 0.054 \text{ pH}$, to hold at 25°C ., from about pH 1 to 12. Furthermore, they found that the potential at the antimony electrode was not affected by the presence of the sulfite radical.

Very recently, Snyder (1928) made use of the antimony electrode with the help of the Franke and Willaman formula, in the determination of the pH of soils, and found it to be in fair agreement with the hydrogen electrode.

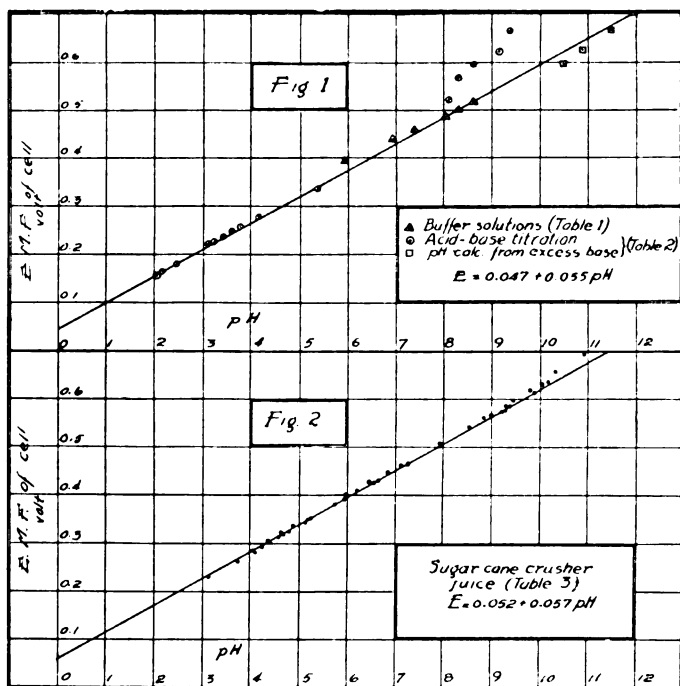


CHART 1

MATERIALS AND METHODS USED

Throughout this work, the temperature of experiment ranged between 26° and 29°C . The quinhydrone electrode in conjunction with the normal calomel electrode was used for determining the pH of the solutions, the

$$\text{formula used being } \text{pH} = \frac{0.4154 - E_{\text{obs}}}{0.06}$$

The antimony electrode was prepared from a Kahlbaum antimony metal powder. A glass tube of about 8 mm. diameter, closed at one end, was heated on a sand bath over a Bunsen burner, and molten antimony poured inside. The hot sand is to prevent sudden cooling, so as to allow normal crystallization of the antimony. As this powder was heated in air,

there was formed the white antimony trioxide (in some cases, the yellow pentoxide), so that there was actually no necessity of adding to the solution of unknown pH the antimony trioxide. The molded antimony was cut into pieces of about three or four centimeters each and forced through pyrex tubes of about the same diameter as the pieces of antimony; the tubes were heated at the junction of the antimony and the glass till the antimony started to melt; when cooled, this prevented the passage of solution inside the glass tube. The tube was then filled with mercury so that contact could be made with the wire leading to the potentiometer.

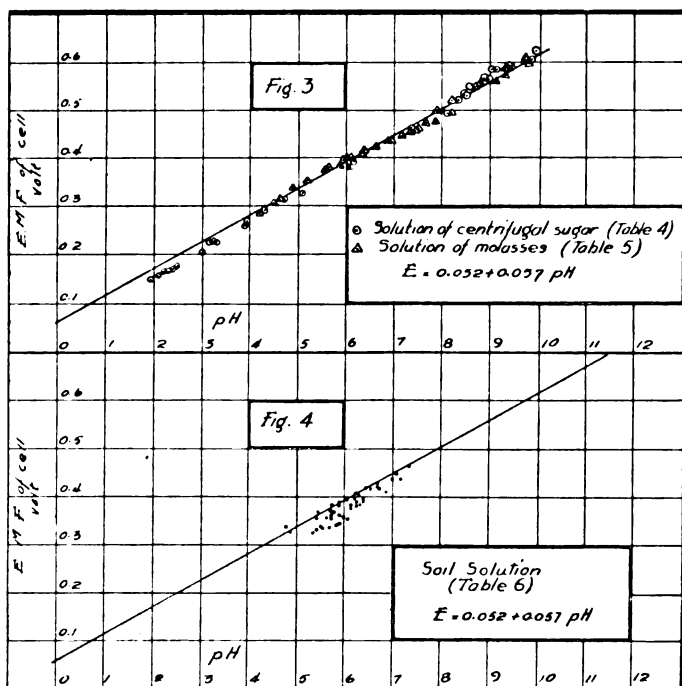


CHART 2

The buffer solutions (KH_2PO_4 — NaOH mixtures) were prepared according to the method described by Clark (1922).

In preparing the acid-base mixtures for partial neutralization, 30 cc. of an approximately one-hundredth normal HCl were added to beakers containing different amounts of approximately one-hundredth normal NaOH , each mixture shaken and divided into two equal portions, one for the quinhydrone electrode, and the other for the antimony electrode.

The same method was used in varying the hydrogen-ion concentration of solutions of centrifugal sugar and molasses. In some cases, the solutions were treated with lime instead of sodium hydroxide, no appreciable dif-

ference in the behavior of the antimony electrode being found by use of either of the two bases.

The method adopted for determining the potential of the Sb electrode consists in putting the Sb electrode in the solution of unknown pH and shaking it during the reading of the potentiometer till the reading is constant. This usually takes place within one or two minutes. It is to be noted that no particular care is necessary in the handling of the antimony electrode, and that no solid or saturated solution is added to the solution. The mechanical work of shaking is no hindrance in the proper reading of the potentiometer, and in the case of sugar clarification the shaking need not be done, as the flow of the juice would be a proper substitute.

The soils used were representative soils from Negros. No attempt to describe these soils was made, as a more extensive work on the behavior of the antimony electrode in soils is now being conducted for future publication. However, it has been found that without the use of agar bridge^{*} no consistent results could be obtained, especially with quinhydrone. It is for this reason that in the determination of the potentiometer readings of cells containing the soil solution, an agar bridge was employed.

DISCUSSION OF RESULTS

Table 1 shows the potential at the Sb electrode (normal calomel electrode = 0) corresponding to different buffer solutions, the pH being determined by the quinhydrone electrode. The antimony electrode is always negative to the calomel electrode.

Table 2 shows the potential at the Sb electrode corresponding to different mixtures of approximately $N/100$ HCl and $N/100$ NaOH. In table 2 three different Sb electrodes were used, and the fourth reading was taken when Sb_2O_3 powder was added to the solution.

Table 3 shows the potential at the Sb electrode in sugar cane crusher juice, the pH also being determined by the quinhydrone electrode.

Tables 4 and 5 are similar to table 3, except that solutions of centrifugal sugar and molasses were used.

Table 6 shows the potential at the Sb electrode in different soils, no attempt to vary the pH of the samples being made. The pH were also checked by the quinhydrone electrode.

Figure 1, chart 1 shows the relation between the potential at the Sb electrode taken as positive in the figure and the pH of the solutions as determined by the quinhydrone electrode. Figure 1 corresponds to tables 1 and 2, figure 2, chart 1 to table 3, figure 3, chart 2 to tables 4 and 5, and figure 4, chart 2 to table 6.

^{*}For the method of preparing agar bridge for use in soils work, see Bayer, L. D. 1921. The use of the quinhydrone electrode for measuring the hydrogen-ion concentration of soils. *Soil Science* 21: 167-179.

It will be seen from figure 1 that although in buffer solutions, the relation between potential and pH determined by the quinhydrone electrode is linear, in the case of the unbuffered solutions this is not true after pH 5.4. If, however, in the latter case, the pH be calculated from the amount of excess alkali in the solution (assuming 96 per cent ionization), it will be found that the same linear relationship obtains as for buffer solutions and for unbuffered solutions up to pH 5.4. The abnormal curve from pH 5.4 up in the unbuffered solutions must be ascribed to the slight changes in the impurities of the solution (e. g. CO_2 , water itself, soluble glass, etc.), and to the ionization of hydroquinone as a weak acid, thus participating in the acid-base equilibrium through neutralization. In fact, La Mer and Parsons (1923) showed that in the titration of 0.2 N acetic acid with 0.2 N sodium hydroxide the deviation of quinhydrone electrode from the hydrogen electrode is 2.4 pH at pH 8.5, the pH determined by the quinhydrone electrode being the less.

In figure 1 the relation $E = 0.047 + 0.055 \text{ pH}$ was obtained by applying the method of least squares to the data for buffer solutions (table 1) and to the data for unbuffered solutions up to pH 5.4 (table 2).

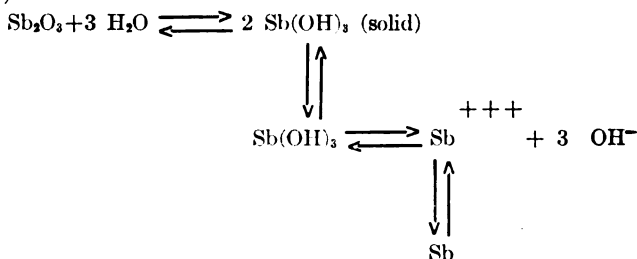
Figure 2 shows the perfect relationship, in crusher juice, between pH determined by the quinhydrone electrode and the potential at the Sb electrode up to pH 9.5. That the relation is not perfect above this pH may be explained by the ionization of hydroquinone as a weak acid, and it would be expected that since sugar cane crusher juices are buffered solutions, the deviations will not be as great as in ordinary acid-base titration, a fact shown by the figure. Since the relation holds good up to pH 9.5, it may be stated that for crusher juice at least, the quinhydrone electrode may be used up to this pH, a conclusion not supported by other workers. It would, however, appear that the Sb electrode has a wider range of application for determining pH than the quinhydrone electrode. Unfortunately, for lack of time, the writers were not able to compare the Sb electrode with the hydrogen electrode, but it is well known that besides being cumbersome the hydrogen electrode also fails when used in the presence of proteins and other "poisons".

From tables 4 and 5 and from figure 3 it is evident that the antimony electrode may also be used to advantage in pH determination of centrifugal sugar and molasses. The equation obtained from table 3 was used in calculating errors in tables 4 and 5. The greater errors obtained in solutions of centrifugal sugar is probably due to the fact that these solutions are not as highly buffered as the crusher juice.

Also, from table 6 and from figure 4 it is evident that the antimony electrode may also be used for determining pH of soils; the errors, however, are not as small as in the case of crusher juice; furthermore, it is not known whether it is the quinhydrone electrode or the Sb electrode which fails. The formula used for calculating the pH from the potentiometer reading is the same as that obtained in table 3.

Theory regarding the behavior of the antimony electrode

The oxidation-reduction reaction at the antimony electrode may be formulated, thus:



The mass action equation for the ionization of the

$$\text{hydroxide is } \frac{(\text{Sb}^{+++}) (\text{OH}^-)^3}{(\text{Sb}(\text{OH})_3)} = K$$

The potential at the oxidation-reduction electrode (Sb electrode) may be written as:

$$E = E_1 - \frac{RT}{nF} \ln \frac{(\text{Red})}{(\text{Oxi})} \quad (1)$$

where E = potential at the Sb electrode
 E_1 = constant, involving electronic concentration of the metal and the equilibrium constant of the oxidation-reduction reaction,
 (Red) = concentration of the reductant,
 (Oxi) = concentration of the oxidant.

The other letters have their usual significance.

Therefore, the potential at the Sb electrode may be written as

$$E = E_1 - \frac{RT}{3F} \ln \frac{(\text{Sb})}{(\text{Sb}^{+++})}$$

or

$$E = E_1 - \frac{RT}{3F} \ln \frac{(\text{Sb}) (\text{OH}^-)^3}{K (\text{Sb}(\text{OH})_3)} \quad (2)$$

Since $\text{Sb}(\text{OH})_3$ is very insoluble, it may be presumed that the amount of the Sb_2O_3 mixed with the metal is sufficient to keep the concentration of the hydroxide constant. The value of (Sb) may also be considered as constant. Furthermore,

$$(\text{OH}^-) = \frac{10^{-14}}{(\text{H}^+)}$$

Therefore, equation (2) may be written as

$$E = E_1 - \frac{RT}{3F} \ln \frac{(\text{Sb}) (10^{-14})^3}{K (\text{Sb}(\text{OH})_3) (\text{H}^+)^3}$$

Gathering the constants,

$$E = E_o + \frac{RT}{F} \ln (\text{H}^+) \quad (3)$$

At $26^\circ - 29^\circ\text{C}$., the value of $\frac{RT}{F}$ is very nearly equal to 0.06, so that transforming into pH,

$$\text{pH} = \frac{E_o - E}{0.06} \quad (4)$$

It is to be noted that the potential at the Sb electrode is negative to calomel, so that taking the sign into consideration, equation (4) is equivalent to equation

$$pH = \frac{E - E_o}{0.06} \quad (4a)$$

Comparing the value, 0.06, of $\frac{RT}{F}$ with the

constant a (from 0.055 to 0.057) which was found from the different solutions, it is seen that there is a little discrepancy between the experimental and theoretical values. Further study is necessary to explain this discrepancy.

SUMMARY

1. The behavior of the Sb electrode has been tested in buffer solutions and in different mixtures of $N/100$ NaOH and $N/100$ HCl. It was found that at 26°–29°C. the pH of a solution may be determined by means of the antimony electrode, and with the help of equation $E = 0.047 + 0.055 \text{ pH}$. The constants found are somewhat different from those reported by previous workers.

2. This electrode was also tested in sugar solutions and the relation found, at 26°–29°C., is

$$E = 0.052 + 0.057 \text{ pH}$$

It is suggested that since the Sb electrode requires no particular care, is mechanically sturdy, cheap, gives a quick response after being placed in solution, and has a wider range of pH values at which it can be used, this electrode may be used to advantage in the continuous reading of pH in sugar juice during clarification. For sugar clarification the potential range to be registered by the recording apparatus must be between 0.25 to 0.55 volts, corresponding to from pH 4 to pH 9.

3. The antimony electrode has also been tried for use with soils, with results similar to those obtained by Snyder. More experiments are being carried out to explain the cause of the errors involved.

4. The value of the constant a calculated from the writers' data

differs somewhat from the value of $\frac{RT}{F}$ ($=0.06$) which is according to

theory, but this discrepancy is not appreciably large. Further experiments are necessary to explain this difference.

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TABLE 1

e. m. f. of Sb, Sb₂O₃—HA—calomel, at different pH. (t = 26° - 29°C.)

PH OF BUFFER SOLUTION (DETD. BY QUINHYDRONE ELECTRODE)	E. M. F. OF CELL CONTAINING BUFFER SOLUTIONS					MAXIMUM DEVIATION FROM MEAN
	1 volt	2 volt	3 volt	4 volt	(mean) volt	
5.98	0.388	0.389	0.390	0.391	0.390	0.002
6.96	0.436	0.439	0.439	0.438	0.438	0.002
7.44	0.455	0.460	0.457	0.459	0.457	0.003
8.06	0.484	0.484	0.483	0.482	0.483	0.001
8.36	0.500	0.503	0.500	0.501	0.501	0.002
8.67	0.521	0.521	0.518	0.519	0.520	0.002

TABLE 2

Relation between e. m. f. of cell, Sb, Sb₂O₃—HA—calomel, and pH (t = 26° - 29°C.)
 Acid-base titration (approximately N/100 HCl against approximately N/100 NaOH)

ACID	BASE	MEAN OBS. E. M. F. OF CELL	E = 0.047 + 0.055 pH				DIFF. (OBS.—CALC. PH)
			Max. devia- tion from mean	Obs. pH by the quin. electrode		Calc. pH	
cc.	cc.	volt	volt				
30	0	0.158	0.002	2.07		2.02	+0.05
30	5	0.164	0.002	2.22		2.13	+0.09
30	15	0.182	0.002	2.51		2.45	+0.06
30	25	0.219	0.002	3.15		3.16	-0.01
30	26	0.226	0.001	3.25		3.25	0
30	27	0.238	0.003	3.45		3.47	-0.02
30	27.5	0.247	0.002	3.60		3.64	-0.04
30	28	0.256	0.002	3.78		3.80	-0.02
30	28.5	0.279	0.002	4.21		4.22	-0.01
30	29	0.335	0.006	5.39		5.24	+0.15
(30)	(29.5)	(0.386)		(6.46)			
(30)	(29.5)	(0.349)	?	(6.45)			
(30)	(30)	(0.422)	?	(7.28)			
(30)	(30)	(0.399)		(7.37)			
30	30.5	0.521	0.010	8.13		8.62	-0.5
30	31	0.565	0.010	8.36		9.42	-1.1
30	32	0.593	0.004	8.64	(10.49 ^a)	9.93	+0.6
30	35	0.624	0.004	9.14	(10.87 ^a)	10.49	+0.4
15	30	0.664	0.006	9.39	(11.50 ^a)	11.22	+0.3
0	30	0.704	0.006	10.84	(11.98 ^a)	11.94	+0.04

^a Calculated from the amount of excess base, assuming 96 per cent ionization.

TABLE 3

Crusher juice at 26° - 29°C.
Relation between pH (determined by the quinhydrone
electrode) and the potential at the Sb electrode
 $E = 0.052 + 0.057 \text{ pH}$

NO.	pH (QUINHY- DRONE)	OBS. E. M. F. AT SB	CALC. pH	(OBS.-CALC.) pH
		<i>volt</i>		
1	4.72	0.321	4.72	0.00
2	4.92	0.336	4.98	-0.06
3	5.14	0.346	5.16	-0.02
4	5.22	0.350	5.23	-0.01
5	5.74	0.380	5.72	+0.02
6	5.99	0.400	6.11	+0.12
7	6.24	0.408	6.25	-0.01
8	6.49	0.424	6.53	-0.04
9	6.65	0.430	6.64	+0.01
10	6.88	0.448	6.95	-0.07
11	9.22	0.572	9.13	+0.09
12	9.36	0.583	9.32	+0.04
13	10.05	0.632	10.18	-0.13
14	3.14	0.233	3.18	-0.04
15	4.08	0.282	4.04	+0.04
16	4.41	0.305	4.44	-0.03
17	4.60	0.311	4.55	+0.05
18	4.80	0.322	4.74	+0.06
19	5.24	0.352	5.62	-0.02
20	5.95	0.385	5.84	+0.12
21	6.57	0.428	6.60	-0.03
22	7.25	0.461	7.18	+0.07
23	7.93	0.501	7.88	+0.05
24	8.57	0.540	8.56	+0.01
25	9.26	0.575	9.18	+0.08
26	9.77	0.615	9.70	+0.07
27	3.73	0.263	3.70	+0.03
28	4.11	0.282	4.04	+0.07
29	4.29	0.293	4.23	+0.06
30	4.43	0.301	4.37	+0.06
31	4.69	0.321	4.72	-0.03
32	7.35	0.459	7.14	(+0.21)
33	8.85	0.561	8.93	-0.08
34	9.00	0.567	9.04	-0.04
35	9.88	0.612	9.83	+0.05
36	9.31	0.584	9.33	-0.02
37	9.45	0.594	9.51	-0.06
38	10.17	0.642	10.35	-0.18
39	10.35	0.654	10.56	-0.21
40	10.93	0.692	11.23	-0.30
41	11.21	0.719	11.70	-0.49
42	11.98	0.755	12.33	-0.35
43	12.22	0.780	12.77	-0.55
44	6.89	0.450	6.98	-0.09
45	7.42	0.462	7.09	(+0.33)
46	7.91	0.500	7.86	+0.05

TABLE 4

*Solution of centrifugal sugar (10%) at 26° - 29°C.
Relation between pH (determined by the quinhydrone
electrode) and the potential at the Sb electrode.*

$$E = 0.052 + 0.057 \text{ pH}$$

NO.	pH	OBS. E. M. F. AT Sb	CALC. pH	DIFF. (OBS.- CALC.) pH
		volt		
1	2.22	0.162	1.93	+0.29
2	2.50	0.175	2.16	+0.34
3	3.16	0.226	3.05	+0.11
4	3.91	0.260	3.65	+0.26
5	4.33	0.295	4.26	+0.07
6	6.19	0.391	5.95	+0.24
7	7.40	0.459	7.14	+0.26
8	8.53	0.532	8.42	+0.11
9	8.59	0.551	8.75	-0.16
10	8.90	0.562	8.95	-0.05
11	8.98	0.565	9.00	-0.02
12	9.45	0.593	9.50	-0.05
13	9.13	0.584	9.33	-0.20
14	9.96	0.628	10.11	-0.15
15	1.97	0.150	1.72	+0.25
16	2.16	0.158	1.86	+0.30
17	2.32	0.163	1.95	+0.37
18	2.43	0.170	2.07	+0.36
19	3.00	0.208	2.74	+0.26
20	3.24	0.222	3.00	+0.24
21	3.30	0.226	3.07	+0.23
22	3.92	0.267	3.77	+0.14
23	4.74	0.311	4.54	+0.20
24	5.09	0.325	4.79	+0.30
25	8.15	0.494	7.76	+0.39
26	8.36	0.523	8.26	+0.10
27	9.05	0.586	9.37	-0.32
28	9.40	0.596	9.54	-0.14
29	9.84	0.610	9.79	+0.05
30	6.38	0.403	6.16	+0.22

TABLE 5

*Solution of molasses (10%) at 26° - 29°C.
Relation between pH (determined by the quinhydrone
electrode), and potential at the Sb electrode
 $E = 0.052 + 0.057 \text{ pH}$*

NO.	pH (OBS.)	OBS. E. M. F.	CALC. pH	DIFF. (OBS.-CALC.) pH
		<i>volt</i>		
1	5.55	0.374	5.65	-0.10
2	5.62	0.377	5.70	-0.08
3	5.86	0.386	5.86	-0.00
4	5.93	0.394	6.00	-0.07
5	6.12	0.400	6.11	+0.01
6	6.39	0.412	6.32	+0.07
7	6.63	0.422	6.49	+0.14
8	6.87	0.433	6.69	+0.18
9	7.18	0.445	6.90	+0.28
10	7.44	0.456	7.09	+0.35
11	7.86	0.475	7.42	+0.44
12	7.50	0.457	7.11	+0.39
13	8.48	0.534	8.46	+0.02
14	8.79	0.558	8.88	-0.09
15	9.32	0.577	9.21	+0.11
16	9.80	0.600	9.61	+0.19
17	4.19	0.285	4.09	+0.10
18	4.52	0.309	4.51	+0.01
19	4.65	0.318	4.67	-0.02
20	4.92	0.337	5.00	-0.08
21	5.20	0.351	5.25	-0.05
22	5.99	0.397	6.05	-0.06
23	6.89	0.434	6.70	+0.19
24	7.67	0.471	7.35	+0.32
25	8.17	0.493	7.74	+0.43
26	9.11	0.563	8.96	+0.15
27	9.34	0.587	9.39	-0.05
28	9.46	0.596	9.54	-0.08
29	6.15	0.408	6.21	-0.06
30	6.91	0.437	6.76	+0.15
31	7.19	0.449	6.97	+0.22
32	7.35	0.453	7.03	+0.32
33	7.54	0.464	7.23	+0.31
34	7.89	0.500	7.86	+0.03
35	8.26	0.522	8.25	+0.01
36	8.68	0.549	8.72	-0.04
37	9.70	0.611	9.81	-0.11

TABLE 6

*Solutions of soils at 26° - 29°C.
Relation between pH (determined by the quinhydrone
electrode) and the potential at the Sb electrode
 $E = 0.052 + 0.057 \text{ pH}$*

INDEX NO. ^a	pH (OBS.)	OBS. E. M. F. AT Sb ELECTRODE	CALC. pH	DIFFERENCE (OBS.-CALC.)
		volt		
4-A Isabela....	5.81	0.369	5.56	+0.2
42-B Manapla...	6.75	0.413	6.33	+0.4
13-B Binalbagan	7.35	0.462	7.19	+0.2
40-B Manapla...	7.07	0.448	6.95	+0.1
11-B Binalbagan	6.23	0.397	6.05	+0.2
10-B Binalbagan	4.86	0.339	5.03	-0.2
13-A Binalbagan	6.89	0.410	6.28	+0.6
37-B Victorias...	5.74	0.360	5.40	+0.3
9-B Binalbagan	5.87	0.385	5.84	0.0
11-A Binalbagan	5.45	0.368	5.54	-0.1
36-A Victorias...	6.47	0.418	6.42	+0.1
38-B Victorias...	6.72	0.428	6.60	+0.1
13-B Isabela....	7.18	0.435	6.72	+0.5
12-B Binalbagan	6.71	0.421	6.47	+0.2
9-A Binalbagan	6.03	0.390	5.93	+0.1
8-B Isabela....	5.91	0.384	5.82	+0.1
2-A Isabela....	6.29	0.401	6.12	+0.2
20-A La Carlota.	6.26	0.388	5.89	+0.4
6-A Isabela....	6.29	0.403	6.15	+0.1
6-B Isabela....	6.55	0.417	6.40	+0.1
14-B La Carlota.	6.15	0.381	5.77	+0.4
20-B La Carlota.	6.12	0.375	5.67	+0.4
1 (clay) Isabela..	7.00	0.435	6.71	+0.3
16-A La Carlota.	5.42	0.354	5.30	+0.1
16-B La Carlota.	5.72	0.379	5.74	-0.2
17-A La Carlota.	5.87	0.381	5.73	+0.1
17-C La Carlota.	6.42	0.391	5.95	+0.5
20-C La Carlota.	6.32	0.381	5.77	+0.5
14-A La Carlota.	6.39	0.394	6.00	+0.4
15-B La Carlota.	6.25	0.384	5.82	+0.4
19-B La Carlota.	6.12	0.374	5.64	+0.5
21 La Carlota.	5.72	0.356	5.33	+0.4
22 La Carlota.	5.63	0.352	5.26	+0.4
30-B Talisay....	5.89	0.361	5.42	+0.4
32-A Talisay....	6.61	0.376	5.68	+0.9
32-B Talisay....	6.18	0.365	5.49	+0.7
33-A Talisay....	4.91	0.328	4.84	+0.1
33-B Talisay....	5.74	0.370	5.58	+0.1
34-A Talisay....	5.54	0.330	4.88	+0.7
35-A Talisay....	5.91	0.345	5.14	+0.8
35-B Talisay....	5.86	0.340	5.05	+0.8
15-A La Carlota.	6.10	0.356	5.33	+0.7
19-A La Carlota.	5.67	0.337	5.00	+0.7
23-A Bacolod ...	5.57	0.334	4.95	+0.6
25-A Bacolod ...	5.45	0.355	4.95	+0.5
26-A Bacolod ...	5.37	0.327	4.82	+0.5
28 Bacolod....	5.55	0.338	5.02	+0.5
29-A Bacolod ...	6.01	0.357	5.35	+0.6

^aThe soils together with their index numbers were obtained from Dr. R. L. Pendleton of the Soils Division, Department of Agronomy.

PHILIPPINE FARMERS' TAX GUIDE¹

JOSE E. VELMONTE

Of the Department of Rural Economics

The power of taxing the people and their property is essential to the very existence of government, and may be legitimately exercised on the objects to which it is applicable to the utmost extent to which the government may choose to carry it. The only security against the abuse of this power is found in the structure of the government itself.—CHIEF JUSTICE MARSHALL.

The Philippine farmers constitute an important unit of the tax-paying population of the country. They contribute heavily to the support of the government in the payment of the Real Property tax and Income tax. Taxes on real property alone, the greater portion of which is paid by farmers, rank equal in importance as a source of government revenue with Business taxes, with Excise taxes, and with Import duties. The assessed valuation of real property subject to taxation in recent years is nearly ₱1,600,000,000 from which real property taxes of nearly ₱15,000,000 were collected. This tax which accrues to provinces and municipalities represents over 55 per cent of their total revenue from taxation.

In general, apathy towards paying taxes is common in the Philippines, hence they are often paid grudgingly. The methods of levy are not well understood, much less the spirit of taxation. Many a farmer has hazy ideas of his rights and privileges as provided by the laws to safeguard his interests against unjust impositions and practices. Consequently, there arises a tendency to seek excuses for evasion or delay in the payment of taxes, and there are likely to be partialities in the application of the tax laws to the detriment of the uninformed. There is, then, a great need for so important a body of taxpayers as our farmers to know the text of the tax laws which directly affect them so that they may understand the reasons for taxation, the methods of levy and collection, the penal provisions, and their rights and privileges in regard to taxation.

The task of levying and collecting taxes is vested in officials of the government. In the difficult and complicated nature of their work, inequalities and apparent partialities in the application of the tax laws often arise. The laws of the Philippine Islands provide ample safeguards of the rights and privileges of taxpayers against any abuse or injustice. Means for redress against unjust impositions and for the protection of the farmer's rights are provided. The present paper aims to help acquaint tax-paying

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farmers with the operation of important tax laws which directly concern them, and with their rights and privileges.

THE REAL PROPERTY TAX

Levy and disposition of proceeds of tax

The tax based on the value of real estate, which includes land, buildings, and other improvements, constitutes the real property tax. It is more commonly designated as the land tax, for a very great part of the taxable real property of the Islands consists of land, most of which is farm land. The proceeds of this tax go to meet the expenses of the provinces and municipalities where the land is situated. The minimum rate of taxation is three-eighths of one per cent of the value of real property, and the maximum rate of levy is seven-eighths of one per cent. The share of a province is levied by the provincial board upon a resolution passed on or before the last day of December of each year fixing a uniform rate of taxation for the succeeding year. The rate of levy is not less than one-eighth nor more than three-eighths of one per cent. The share of a municipality is likewise levied by passage of a municipal ordinance fixing a uniform rate of not less than one-fourth nor more than one-half of one per cent. Under actual practice, there is in force at the present time in the provinces and municipalities the maximum rate of seven-eighths of one per cent allowed by law. This rate has remained unchanged from year to year, with the provinces and municipalities sharing in the proportions specified by the tax law. The gross proceeds of the tax collected go to meet specified expenses of both the provincial and municipal governments. The proceeds of the first one-eighth of one per cent of the provincial levy accrue to its road and bridge fund, the proceeds of the remaining two-eighths of one per cent, to its general fund. The gross proceeds of the first one-fourth of one per cent of the municipal levy accrue exclusively to its school fund, the proceeds of the remaining one-fourth of one per cent to its general fund.

Assessment of the real property tax

There is in every province a provincial assessor. The provincial treasurer performs the duties of the provincial assessor at the present time. There may be appointed by the provincial assessor deputy assessors to help him perform the duties which his position carries. Owners and administrators of real property, that is land, buildings, and other improvements, are required by law to make a sworn declaration of their taxable property for purposes of taxation before the provincial assessor or the municipal secretary of the town where their real property is situated. Two classes of real property are recognized, rural and urban, for which separate forms for declaration purposes are provided in the office of the municipal secretary. If the land has been registered in the court of land registration, the number of the certificate of title should be given in the declaration and if the land

has been included in a cadastral survey, the lot number. Otherwise, sufficient description of boundaries should be given to make identification easy. The kind, area, annual production, and value of the land and improvements thereon should be given. Failure by an owner to declare any real property subject to taxation gives the assessor the right to make the required declaration for purposes of assessment and taxation. A notice of such action is sent to the owner. Farmers are allowed the following exemptions from taxation of certain properties:

- a. Land held by a homesteader prior to obtaining a patent.
- b. Machinery, this includes tools and implements used for agricultural purposes.
- c. Fruit trees and bamboo plants growing on the farmer's land.

Each municipal council is required by the provincial board to prepare and submit a general schedule of the values of the different classes of land in the municipality. When the schedule of values is found to be impartial, just, and equitable, it is made the basis by the provincial assessor in his work of valuation and assessment of real properties. Any divergence of opinion between the municipal council and the provincial assessor arising from the equity of the schedule of values is given a hearing and decided by the Chief of the Executive Bureau; his decision must be approved by the Secretary of the Interior before it is valid.

The principle governing valuation of land and improvements is that the assessor should value them at their true and full value in accordance with the schedule of values in force in the municipality wherein they are situated. The assessor is therefore not bound to be guided by the sworn declaration of the owner as to valuations. The assessor may raise or lower valuations should he deem the change proper. In case the real property is assessed at a value greater than that appearing in the declaration of the owner, or when existing assessment is increased, the assessor is required to give immediate notice to the owner, executed in proper form provided for the purpose. Should the taxpayer consider the value assessed against his real property by the assessor to be excessive or unjust, he may file with the municipal council a written statement of his objections to the action of the assessor. Such appeal is executed in a prescribed form obtainable at the office of the municipal secretary and it should be accompanied by the owner's original declaration. Any written proofs to strengthen his claims may accompany his appeal and oral argument may be made before the municipal council. Should taxes on the property become due while the appeal is pending, they should be paid "under protest," for a refund of any excess in taxes may later be claimed if the appeal is decided in the owner's favor. Action by the municipal council is required within thirty days after receipt of such appeal. From the decision of the municipal council, appeal may be made within ten days to the provincial board, either by request of the aggrieved farmer or by the provincial assessor. Appeal from the decision

of the provincial board as to the justice and equity of particular assessments, may be made either by the owner of the property or by the municipal council to the Chief of the Executive Bureau whose decision as to the fairness of the assessment is final when approved by the Secretary of the Interior and concurred in by the Governor General. Procedure of such appeals may be found in the form for appeals referred to above.

Revisions of valuations of land and other real property in any province or municipality may be made only once in two years when the provincial assessor is so directed by the provincial board.

The collection of the real property tax

The real property tax becomes due and payable to the municipal treasurer on the first day of January of each year. According to law the Governor General fixes a special period of three months in each year for the collection of the tax in the respective provinces. The period fixed may be any three successive months of the year. The Governor General must act before the last day of December of the year preceding that in which it is to take effect, and at least three months before the beginning of the period fixed. The term of collection may be extended for another three months by the provincial board upon approval of the Governor General. The special term of collection of the tax in any province may be postponed at the discretion of the Governor General to any period within the year. In case of calamities, as general failure of crops or other wide-spread disaster in any specified district, the tax may be remitted wholly or partially by action of the provincial board and approved by the Secretary of the Interior or by order of the Governor General. Notices are posted in every municipality designating the period during which the real property tax is payable, and the municipal treasurer collects and receives the tax from taxpayers.

In accordance with present practice, the land tax is due and payable in organized provinces not later than May 31. In certain provinces there are special periods for collection to suit local conditions. Land tax in Palawan must be paid on or before June 30; in Abra, Batanes, and La Union, on or before July 31; in Cagayan and Isabela, on or before November 30.

Penalties

For the enforcement of the collection of the land tax, three kinds of penalties are imposed in case of delinquency. A progressive rate of surcharges is added to the tax, personal property of the delinquent taxpayer may be subject to seizure and sale, and finally land on which the taxes are not paid is held subject to forfeiture to the government whose title after a certain period becomes absolute.

After May 31, the last day for the payment of the real property tax, a penalty of 10 per cent of the tax due is added when it is paid not later than September 30; the penalty increases to 20 per cent when paid after the last

date but not later than December 31; if the delinquency continues, a penalty of 30 per cent is imposed when the tax is paid not later than March 31 of the year following; and the penalty is increased to 40 per cent when paid after the last mentioned date.

When delinquency in the payment of the tax occurs, personal property of the taxpayer may be subject to seizure by the provincial treasurer or his deputy, and so much of it may be sold at public auction as to satisfy taxes due, together with the penalties and costs. Some items of personal property of the farmer are not subject to seizure and sale, the most important of which are:

- a. Tools and implements.
- b. One horse, cow or carabao.
- c. Necessary clothing of the family.
- d. Household furniture and utensils not exceeding ₱75 in value.
- e. Provisions for family use sufficient for three months.

If on June 1 one year after a tax was due on land, and no seizure of personal property has been made, the tax and penalties remain unpaid, the land is forfeited to the government. Ninety days from date of notice of such delinquency issued by the provincial treasurer, government title to the land becomes absolute, the owner is dispossessed of it, occupants are ejected, and the land is subject to sale and disposition.

Redemption

The delinquent taxpayer is given every opportunity to safeguard his personal interests even after penalties have been imposed for non-payment of taxes. When any personal property is seized for non-payment of taxes, the owner may redeem it before sale is made by paying the tax, penalty, and costs incurred. After the delinquent land is forfeited to the government and within ninety full days from date of notice published stating such forfeiture, the owner may redeem the land, by the payment of taxes and penalties due. After the lapse of ninety days from the publication of this notice, if land is not redeemed, government title to the land becomes absolute and is subject to sale and disposition. The owner is, however, given the further right of repurchase from the government before any sale is made, by the payment of all taxes, penalties, and costs due, plus an additional charge of 10 per cent of the whole amount.

THE FARMER'S INCOME TAX

Farmers, of course, like all other persons, are subject to an income tax levied and collected annually on net income as defined by law. All farmers having a gross income of ₱4,000 or more, for the taxable year, are required to file income tax returns with the treasurer of the province, or municipal treasurer of the municipality where they are resident, although the returns may show no tax liability. These returns made on special forms, which

are furnished, must be filed after the close of the calendar year, and on or before the first day of March. Failure to file such returns on time, subjects the delinquent to payment of a penalty of fifty per cent of the amount of the tax and a specific penalty of from 40 to 2,000 pesos. Fraudulent returns showing understatement of income subjects one to a penalty of one hundred per cent of the tax due, and he is liable to a specific fine not exceeding ₱4,000 or imprisonment of not exceeding one year, or both.

The gross income of the farmer includes the total amount received from the sale of crops, live stock and other farm products, plus the receipts from other sources as, salaries, wages, or commissions received during the year, gross income from any other business he conducts or from any trade in which he has an interest, rents received, interest received and other income. As the tax is levied upon net income, the farmer in submitting his personal income tax returns should ascertain his net income after itemizing his gross income. Certain specific deductions from gross income are allowed by law, the most important of which are as follows:

1. Amounts paid by the farmer for labor in preparing his land for a crop, and the cultivation, harvesting, and marketing of the crop.
2. Cost of the seeds and fertilizers used.
3. Amounts paid for labor in caring for live stock.
4. Cost of feed for live stock.
5. Expenses in repairing farm buildings, except dwelling house.
6. Expenses in repairing fences, farm machinery, etc.
7. Cost of materials for immediate use, and of ordinary farm tools of small cost which are used in the course of a year or two.
8. Rent paid for the farm.
9. Taxes paid during the year except special assessments and inheritance taxes.
10. Interest paid within the year on indebtedness.
11. Losses incurred in the operation of the farm. Loss by storm, flood or fire may be deductible if the value of crop has been returned as income. Cattle raisers may claim deductions for animals that die, if the value of such animals have been returned as income. Loss from death of live stock kept for farm use may be deducted not at the full actual purchase price but at this price less depreciation.
12. Depreciation of farm property, such as tools, machinery and live stock.

There are expenses not allowed as deductions from gross income, the most important of these are:

1. Personal, living, and family expenses.
2. Expenses which represent investments of capital as:
 - a. Purchase of farm machinery.
 - b. Permanent tools and equipment of the farm.
 - c. Work animals, and live stock held either for resale or for breeding purposes.
 - d. Expenses for erection of farm buildings.

From the net income, ascertained as outlined above, the farmer is allowed a personal exemption which is deducted from the net income. The exemptions are:

1. For an unmarried person..... ₱4,000
 2. For a married person..... ₱6,000
- A further exemption of ₱400 for each individual child under twenty-one years of age dependent upon such person for support is allowed.

The rate of tax

A normal tax of three per cent is levied upon net income after deductions and personal exemptions have been made. Incomes in excess of ₱10,000 are subject to an additional tax, the rates of which are progressive. These rates are shown in the form for income tax returns.

The collection of the tax

Between January 1 and June 1 the Insular Collector of Internal Revenue notifies all farmers subject to payment of tax of the amount of tax assessed against them. Payment must be made to the municipal treasurer or provincial treasurer not later than June 15 following the taxable year. After this date and ten days after notice and demand have been made, the delinquent taxpayer is subject to pay a penalty of five per cent of the amount of the tax due, and interest at the rate of one per cent per month. He is also liable to payment of a specific penalty of from 40 to 2,000 pesos

Rights and privileges of taxpayer

Returns may be filed after March 1 following the taxable year without subjecting one to the penalties prescribed by law if a request for extension of time is granted by the Collector of Internal Revenue in cases when the delay is caused by absence or illness. Any one feeling that he has been assessed an income tax in excess of his true tax liability may pay the tax so assessed "under protest"; such protest to be made within ten days after payment. This claim is filed with the Collector of Internal Revenue for decision. In case his action is adverse, or if no decision is rendered by him within six months from the date when the protest is made, the taxpayer may proceed at any time within two years after payment of the tax to bring action in the courts against the Collector of Internal Revenue for the recovery without interest of the sum believed to be in excess of his tax liability.

PHILIPPINE REAL PROPERTY TAX CALENDAR FOR FARMERS

- January 1—May 31, inclusive. The real property tax becomes due and payable to the municipal treasurer. Special periods for the collection of the tax are provided for the following provinces: Palawan to June 30 of each year; Batanes, La Union, and Abra to July 31 of each year; Cagayan and Isabela to November 30 of each year.
- June 1—September 30, inclusive. A penalty of 10 per cent is added to the amount of the tax due when paid within these dates. Personal property of delinquent taxpayer is subject to seizure by the provincial treasurer or his deputy and may be sold to satisfy taxes and penalties due.
- October 1—December 31, inclusive. The penalty is increased to 20 per cent of the amount of the tax due when paid within this period. Personal property continues to be subject to seizure and sale.
- January 1—March 31, inclusive. The penalty is increased during this period to 30 per cent and personal property continues to be subject to seizure and sale.
- April 1—May 31, inclusive. The penalty is increased to 40 per cent and personal property is still subject to seizure and sale.
- June 1, and after. The delinquent land is by law forfeited to the government. After ninety days from date of notice of delinquency and forfeiture issued by the provincial treasurer, government title to land becomes absolute, and is subject to sale and disposition.

PHILIPPINE INCOME TAX CALENDAR FOR FARMERS

- January 1—March 1, inclusive. Period for filing with municipal treasurer income tax returns for the last taxable year. Returns filed after March 1 subjects one to the payment of a penalty of 50 per cent of the amount of tax assessed, and a specific penalty of from 40 pesos to 2,000 pesos.
- On these dates, the Collector of Internal Revenue sends out notices to income taxpayers stating amount of tax due and upon date of receipt of notice, the income tax becomes due and payable.
- March 2—June 1, inclusive. The Collector of Internal Revenue continues to send out notices to income taxpayers stating amount of tax due. Income tax continues to become due and payable to municipal treasurers.
- June 2—June 15, inclusive. Income tax continues to become due and payable to the municipal treasurer.
- June 16—and thereafter. After this date, and ten days after notice and demand is made for the tax by the Collector of Internal Revenue, a penalty of 5 per cent of the amount of the tax due is added, and interest at the rate of 1 per cent per month. The delinquent taxpayer is also held liable to payment of a specific penalty from 40 pesos to 2,000 pesos.

FORMS IN CONNECTION WITH REAL PROPERTY AND INCOME TAXES WITH
WHICH FARMERS SHOULD BE FAMILIAR

Real property tax forms

- Provincial Form No. 136—Notice of Assessment, Declared Property. This is issued by the Provincial Assessor when valuations and area reported by the farmer are increased. This form is accompanied by the original declaration of the owner, Provincial Forms Nos. 140 or 141.
- Provincial Form No. 137—Notice of Assessment on undeclared land issued by the Provincial Assessor to owner of undeclared land for his information.
- Provincial Form No. 138—Notice of revision of assessment issued by the Provincial Assessor when assessment reported previously is increased.
- Provincial Form No. 139—Appeal on excessive assessment obtainable at the office of the municipal secretary; filled out by a farmer when he appeals to the municipal council on assessments believed to be excessive or unjust.
- Provincial Form No. 140—Declaration of real rural property filled out by farmers for purposes of assessment. This form is submitted to the Provincial Assessor or his deputy.
- Provincial Form No. 141—Declaration of real urban property filled out by farmers for purposes of assessment. This form is submitted to the Provincial Assessor or his deputy.
- Provincial Form No. 142—Revision of declaration of real rural property forwarded by the Provincial Assessor to the Provincial Treasurer and to the farmer on every authorized revision of assessment.
- Provincial Form No. 143—Revision of declaration of real urban property forwarded by the Provincial Assessor to the Provincial Treasurer and to the farmer on every authorized revision of assessment.
- Provincial Form No. 72—Certificate of absolute forfeiture sent to the Director of Lands by the Provincial Treasurer in case of a lapse of one year of delinquency.

Income tax form

- Bureau of Internal Revenue Form No. 17.01—Income tax returns declaration to be filled out by farmers in the columns applicable to his business.

A STUDY ON THE GROWTH OF COCONUT¹

J. BUENO F. FANDIÑO

WITH ONE CHART

The coconut palm is among the most important of all the valuable oil-bearing plants. The use of its oil as a raw material for the manufacture of human food products began only a few years ago but the demand is growing very rapidly.

The Philippines, in response to this growing demand for coconut products, is increasing, notably, its coconut plantings in some regions. This expansion has brought about a demand for reliable information on the coconut plant.

It is believed that the study here reported on the growth of the nuts will furnish much desired information.

REVIEW OF LITERATURE

Gonzales (1914), Vista (1915), and Copeland (1921) observed that the young nuts are relatively long and slender; later, they grow in width rather than in length, so that finally nearly all the mature nuts of most varieties are wider than they are long. Copeland maintains that these changes in shape are more prominent in the case of the shell than of the whole fruit, including the husk. According to Vista the meat begins to form when the nut is about six months old. Sampson (1923) is more definite and states that the meat commences to form when the nut is about 168 days of age. At 308 days, the meat is fully formed, but the shell husk has not completely hardened. He further says that the shell fully hardens when the nut is ripe, that is, when it is about 364 days old.

TIME AND PLACE OF THE PRESENT STUDY

This investigation was begun during the latter part of April, 1927, but the actual measurement of the nuts began on May 1, of the same year and continued until January 15, 1928. The trees used in this study are located in the coconut grove belonging to Mr. N. Galves in Los Baños Municipality.

MATERIALS AND METHODS

All of the nuts of ten bearing trees were studied². All the bunches on each tree beginning with the oldest were labeled, as bunch 1, 2, 3, etc., and

¹ Thesis presented for graduation, 1928, with the degree of Bachelor of Agriculture, from the College of Agriculture No. 272; Experiment station contribution No. 560. Prepared in the Department of Agronomy under the direction of Dr. Vicente C. Aldaba.

² One tree died in August, 1927, so that the nuts of only nine trees were studied to the end of the investigation.

all the nuts of each bunch were numbered 1, 2, 3, etc., with a light pencil lining beginning with the nut at the base of each cluster. Each nut was marked longitudinally and transversely to indicate the points where measurements were to be made. Weekly measurement was taken, using a wooden caliper.

In order to study the growth of the different parts of the nut, one nut was taken from each bunch of a prolific tree and cut into halves, after measuring its length and width. Fourteen nuts in all stages of growth were thus gathered from the fourteen bunches.

RESULTS

Just after the opening of the spathe most of the young nuts were found to be elliptical in outline with the cross-section diameter greater than the longitudinal. In each bunch, some nuts were found that were nearly round in outline. No nut with longitudinal diameter greater than the transversal was observed.

In analyzing the data the biweekly average of the growth of all the nuts in each bunch was computed and plotted. The chart presented in this paper is typical of all the other nuts studied. It should be mentioned in this connection that all the curves are remarkably similar. It is very interesting to note the relation between the growth in width and in length of the nuts, as shown in the graph. For the first few weeks the growth in width is slower than the growth in length. But during the first few weeks the curve of the growth in width rises more rapidly than the growth in length, until the growth in width becomes much faster than the growth in length. The growth in width remains more rapid than that in length for three or four months and then drops faster than that of the length, so that in the last two or three months the growth in width is again slower than the growth in length.

The measurement of the parts of the nuts at different stages of development are given in table 1. Examining the table, it may be seen that when the nut is about two months old, the endocarp, which becomes the hard shell, begins to appear distinct. It is white, creamy, soft and membranous. From this time on, it thickens gradually until the nut is six to eight months old. About this time the endocarp begins to harden, changing from cream color to brown. Hardening starts at the part opposite the eyes, progressing gradually towards the eyes. This observation agrees with that of Sampson (1923). The endocarp attains its full thickness when the nut is about eight months old.

When the nuts are five months old, the endosperm, which in mature nuts is known as the meat, begins to form at the portion opposite the eye, as a gelatinous substance, somewhat yellowish in color. At the age of six to seven months the endosperm appears to be formed all around the inside of the endocarp, but is still thicker at the bottom. Beginning with the

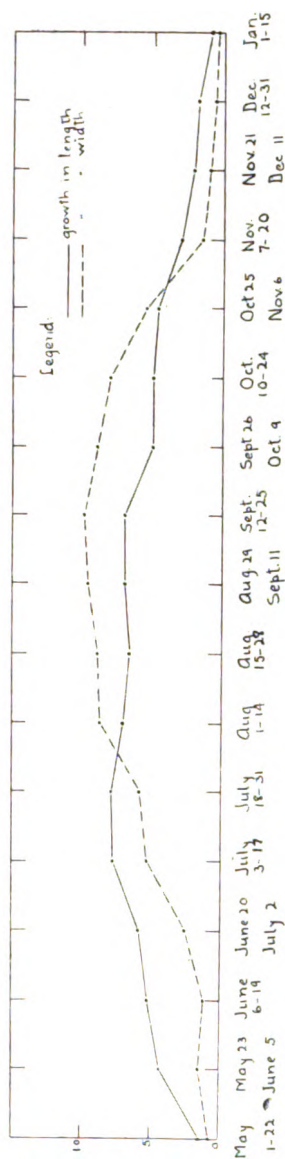


Chart 1.—Showing the average biweekly growth of all the nuts in bunch No. 9 of tree No. 2.

formation of the endosperm up to the time the nut is about nine months old, thickening of the meat is rather rapid. At the age of about nine months the endosperm attains practically its maximum thickness.

The mesocarp, which is known popularly as the husk, varies in thickness at different places. The upper and lower ends of the mesocarp in all nuts appears thicker than the sides. The upper ends thicken rapidly from the time the nut is four and a half months old until it matures, while the two sides of the mesocarp gains in thickness slowly. The mesocarp of the young nut is yellowish in color and rather compact in structure. As the nut matures the color changes to brown.

Measurements of the husked nuts show that the tendency is to grow, when young, in length more than in width. This growth in length continues until the nut is four to four and a half months old. From this age, the tendency is to grow faster in width than in length until the nut matures. At maturity the husked nut is wider than long.

A further study of table 1 shows that from the time the nut begins to grow faster in width than in length, the upper end of the mesocarp thickens rapidly. This explains why the nut with husk is longer than wide, while the husked nut is wider than long.

At the age of nine to ten months the nut attains the full size. The exocarp is still green, turning brown as the nut matures.

DISCUSSION OF RESULTS

From general observation it has been concluded by certain writers that the nut, at first, grows faster in length than in width, and during the rest of its growing life faster in width than in length. This conclusion is only partly correct. As shown in the chart the growth in length is faster than the growth in width during the first few weeks, then for several months the rate of growth in width becomes faster than the rate of growth in length, and in the last period the growth in width is slower than the growth in length.

A detailed examination of table 1 reveals a very interesting phenomenon in the development of the nut. This development may be divided into three more or less distinct stages. In the first stage the growth is mainly in the area of the two parts of the nuts; namely, the husk and shell. This takes place from the appearance of the nut to about the age of four or five months. During this time these parts grow very slowly in thickness. The cavity during this period assumes practically the maximum space. Thus the growth of the husk and the shell are mainly in the direction of increase in surface resulting in greatly increased cavity.

The second stage of growth is from the age of about four or five months to between six and eight months. During this time, the husk and the shell grow very rapidly in thickness. The meat appears, but its growth in thickness is not completed until the nut is about nine months old.

The third and last stage of growth, which is mainly in the direction of maturity, may be considered to begin at the age of eight months. At this stage, the husk changes from dull-white to brown color, and the shell turns from brown to black. With the meat, however, the stage of maturity does not begin until about the age of nine months, when it assumes its full thickness. Then the color begins to change from pure white to dull-white, and the texture becomes very compact.

CONCLUSION

1. The nut grows in length faster than in width at first, then it grows faster in width, and finally again faster in length.

2. There are three more or less distinct stages in the development of the nut: (1) In the first stage, which lasts to the age of four to five months the growth is mainly in area of the husk and the shell; the cavity assumes practically the maximum space during the period; (2) the second stage lasts until the nut is about six to eight months old. The meat appears and the husk and shell grow rapidly in thickness; (3) the third stage is from the time the nut is eight months old until maturity. During this period, the husk, shell, and meat change in color.

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TABLE 1
Measurements of the different parts of the nuts at different stages of maturity

AGE	HUSK				SHELL	MEAT	HUSKED NUT		EXTERNAL MEASUREMENT		HOLLOW PORTION (COMPUTED)	
	Upper end	Lower end	Narrowest side	Opposite the narrowest side			Longitudinal diameter	Cross-sectional diameter	Length	Width	Longitudinal diameter	Cross-sectional diameter
1 month	cm. —	cm. —	cm. —	cm. —	cm. —	cm. —	cm. —	cm. —	cm. 3.1	cm. 3.1	cm. —	cm. —
2 months . . .	0.5	3.0	1.5	1.5	—	—	1.3	0.8	4.9	3.6	1.30	0.80
2½ months . .	0.7	3.0	1.5	1.7	.15	None	3.2	1.5	7.7	4.4	2.05	1.35
3 months . . .	0.8	3.0	1.5	1.7	.20	"	6.1	3.4	9.9	6.3	5.90	3.20
3¾ months . .	0.8	3.0	1.5	1.6	.30	"	8.2	5.8	12.3	8.8	7.90	3.30
4 months . . .	0.8	2.9	1.4	1.7	.30	"	9.2	7.6	13.3	10.8	8.90	7.30
4½ months . .	1.5	2.5	1.6	1.8	.35	"	10.3	10.7	15.2	14.3	9.95	10.35
5¼ months . .	2.7	2.4	1.7	2.1	.35	a	10.7	12.0	17.1	15.9	10.35	11.65
6¾ months . .	3.8	2.5	1.7	2.6	.35	0.3	10.5	12.4	17.6	15.9	9.85	11.75
8¼ months . .	3.5	3.0	1.6	2.3	.40	0.6	11.2	13.2	18.8	17.1	10.20	12.20
9¾ months . .	3.6	3.0	1.7	2.5	.40	1.0	11.1	13.3	19.0	17.6	9.70	11.90
10 months . . .	2.8	2.5	1.6	2.1	.40	1.0	11.5	14.1	18.1	17.9	10.10	12.70
Mature	3.7	2.8	1.4	2.4	.40	1.1	10.7	11.9	17.8	15.8	9.20	10.40
Mature	3.5	2.5	1.3	2.3	.40	1.2	11.7	12.4	19.0	16.3	10.10	10.80

a Formation of the meat at the bottom.

A STUDY ON THE PREPARATION OF HOG RATION AS RELATED TO GROWTH AND DEVELOPMENT OF PIGS¹

SALVADOR F. BOLIVAR

WITH ONE CHART

INTRODUCTION

One of the factors determining success or failure in pork production is the manner in which feeds are prepared before giving them to hogs. The feeds making up the ration should meet the physiological needs of the pigs and the feeder's requirement—economy. Proper preparation may help the feeds to meet both objects.

It is a common practice among hog feeders in the Philippines to cook or to prepare feeds in the most convenient way without regard to the class and condition of the pigs, or to the changes that may take place in the physical and chemical composition of the feeds.

Several ways of preparing feeds are known in this country, but just which to recommend under a given condition or set of conditions is not known. It was the object of this investigation to determine what manner of preparation of the hog ration should be advised for weanling pigs.

Past work on the subject

Allen (1901) compared cooked or steamed barley meal, corn meal, and shorts; whole corn; whole corn and shorts; peas, corn, and oatmeal; potatoes, and a mixture of peas, barley, and rye with the same feeds uncooked. He found that in ten trials there had been no gain from cooking, instead, there has been a positive loss.

Spencer (1913) reports the results of feeding cooked potatoes, carrots, meal (corn and barley), milk, and alfalfa to 17 three months old pigs which made a daily gain of 1.2 pounds a pig; they required 3.23 pounds of dry matter to produce 1 pound live weight. Another set of 17 pigs fed on the same ration but uncooked made an average daily gain of 1.32 pounds; they required 2.96 pounds of dry matter to produce 1 pound live weight.

Henry (1894) in his work with pigs, using corn meal which had been cooked into a thick mush and corn meal moistened with hot water and fed at the same temperature as the mush, found that it required 439 pounds of cooked feed, or 454 pounds of uncooked feed to make 100 pounds of gain.

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Smith (1920) states that cooking is a detriment rather than a benefit with the usual hog feeds.

Henry and Otis (1907) report that 140 pigs fed a ration of shelled corn as the principal feed consumed an average of 501 pounds ration for every 100 pounds gain. Another lot of 140 pigs with corn meal as the principal feed required 471 pounds ration for the same amount of gain.

Wheeler (1893) compared corn meal with ear corn on 2 lots of 4 pigs, for 63 days. Pigs on corn meal made larger and more economical gains than pigs on ear corn.

Stewart and Atwood (1899) experimenting on feeding whole corn and corn meal to 3 lots of 3 pigs each, found that pigs receiving whole corn required 5.39 pounds to make a pound of gain, and of the two lots receiving corn meal, one required 4.75 and the other 4.63 pounds of corn meal to make a pound of gain.

Kennedy and Robbins (1909) state that pork produced from 312 hogs fed on soaked corn meal costs more per pound gain than from hogs fed on soaked shelled corn.

Mackay (1894) in experiments where 4 pigs were fed wheat soaked for 24 hours found that the pigs made 1 pound gain for every 4.5 pounds ration. Another lot of 6 pigs on boiled wheat ration made 1 pound gain for every 6 pounds of ration.

Stewart and Atwood (1899) in their work with 2 lots of 6 pigs each, where one lot was fed whole corn soaked in water until soft and the other lot was fed with corn meal mixed with water, report that the pigs fed whole corn, soaked, consumed 3.85 pounds for every pound of gain. Those fed on corn meal required 4.1 pounds for every pound of gain.

Bliss and Lee (1914) report that 10 pigs fed soaked ground wheat for 84 days consumed 4.43 pounds per pound of gain. Ten pigs fed soaked whole wheat for the same length of time consumed 5.91 pounds for every pound of gain. Nine pigs on a 98-day test fed on whole wheat, soaked, required 5.04 pounds of grain per pound of gain, while another lot of 9 pigs fed on ground wheat, soaked, needed only 4.13 pounds of grain for every pound gain.

The Ohio Experiment Station reported in 1922 that hogs fed on shelled corn made returns of 2 cents a bushel more than hogs on ear corn; fed on corn meal, 8 cents a bushel more; on corn meal moistened as a slop, 9 cents a bushel more.

Object of the experiment

The object of this experiment was to determine, for weanling pigs, the most efficient preparation for a ration consisting of 20 parts corn, 60 parts rice bran, 15 parts copra meal, and 5 parts dried shrimps with 1 per cent of a mineral mixture added to the ration.

Time and place of the work

These experiments were conducted at the Public Breeding Station of the Department of Animal Husbandry, College of Agriculture. The first experiment was started on July 5 and closed on August 29, 1926, covering a period of 55 days. The second experiment was started on May 1 and closed on July 10, 1927. The third experiment was started on September 4 and closed on November 13, 1927. Each of the two last experiments covered a period of 70 days.

MATERIALS AND METHODS

Materials

The animals. The pigs used in the first experiment were 18 barrows purchased in the market of Calamba. They were about three and one-half months old at the beginning of the experiment. The animals were rather spare in condition. Judging from appearance, they were grade Berkshire pigs, about one-fourth Berkshire.

For the second experiment fifteen barrows were purchased in Calamba on April 22, 1927. They were about three and one-half months old, uniform in size and condition. They were Berkshire-Native grades.

Another lot of fifteen pigs of practically the same type, age, size, and condition as the pigs used in experiment II were bought in Calamba for the third experiment. Twelve were barrows and three were females.

Methods

Experiment I. There were two lots of pigs in this experiment. Both lots received the same ration, except that lot I was given uncooked ration, and lot II cooked ration.

Experiment II. Lot I ration was similar to that of lot I in experiment I except that the corn was shelled (instead of ground); lot II was given the same ration as lot I in experiment I except that the ration was soaked 10 to 14 hours before feeding, (instead of adding the water immediately before feeding as was done for lot I in experiment I). Lot III had exactly the same ration as lot I in experiment I.

Experiment III. Lot I received a soaked ration with shelled corn; lot II received a cooked ration with shelled corn; and lot III received a soaked ration with the corn ground.

It will be noted that there were placed under test six preparations of the same feeds and in the same proportion; namely,

1. Ration with ground corn; water added just before feeding.
2. Ration with ground corn; cooked.
3. Ration with ground corn; soaked.
4. Ration with shelled corn; water added just before feeding.
5. Ration with shelled corn; cooked.
6. Ration with shelled corn; soaked.

Feeding. All the lots in the three experiments were fed twice daily, between 6:00 and 7:00 a. m. and 4:00 and 5:00 p. m. The pigs were allowed all the feed they could easily consume. After feeding in the morning, clean water in clean troughs was placed before them. This was replenished at 11:00 a. m.

Weighing. The pigs were weighed weekly. All weights were taken at 4:00 p. m. before the pigs received their evening meal.

Care and management. Experiment I: The two lots of pigs were dry lot fed. There was no pasture available. Each lot occupied a pen in the hog house with an adjoining yard, 491.5 square meters in area. In the two adjoining yards occupied by the two lots there was always grass growing. However, very little of this grass could be utilized by the pigs as it was soiled and trampled the greater part of the time.

Experiment II and III: The pigs were separated by lots only at feeding. Between meals at night and in the day time all the pigs in the three lots of both experiments were allowed to run together in a common grass pasture, largely *Paspalum conjugatum*. It may be noted in this connection that by taking care that each lot of pigs was fed in the same pen and at the usual hours the pigs learned to separate themselves by lots and to run together in the same pasture after each feeding.

There were four pastures, one-sixteenth of a hectare each, available for use in these experiments. These were used in rotation of two weeks duration—that is, the pigs were allowed to use one pasture at a time for two weeks, then they were turned into the second pasture for the next two weeks and so on. In this manner the pigs were able to get a limited amount of fresh grass throughout the experimental periods.

There were trees growing all along the borders of the pasture lots, which served as shelter; a temporary shed of coconut leaves was erected in each pasture to protect the pigs from the heat of the sun. During stormy weather the pigs were put in the hog house.

Observations. Experiment I: (1). During the first few days the pigs on cooked ration did not relish their feed as much as did the pigs on uncooked ration. They got over this within two weeks. Throughout the feeding period, however, it was noted that it took the pigs on cooked ration longer to finish their meals, than the ones on uncooked.

(2). On August 2, following the discovery of ascaris infestation, the following prescription was given:

Oil of chenopodium	20 cc.
Tartar emetic	5 grams.
Oil of turpentine	75 cc.
Castor oil	225 cc.

Fifteen cc. was administered for every 10 kilograms live weight of the pigs. Both lots were heavily infested, as shown by the number of ascaris expelled.

(3). As the experiment proceeded, lot II, or the cooked ration lot frequently showed signs of loss of appetite, and at the same time the pigs frequently showed a strong liking for grass or any green feed accessible to them.

(4). Pigs in lot I appeared more vigorous and healthier than those in lot II.

(5). On August 3, pigs 164, 165, and 170 in lot I were found to be sick; they remained so for about a week. Pig 160 was sick for two weeks.

(6). On August 29 the experiment was brought to a close, as nearly all the pigs in both lots showed signs of sickness. There was an outbreak of *Hemorrhagic septicemia*.

Experiment II: (1). During the first three days of the experiment the pigs in lot I (shelled corn, unsoaked) did not seem to relish their feed, but later, showed good appetite which continued until the end of the experiment.

(2). Lot II (corn meal, soaked) consumed the greatest amount of feeds from the beginning up to the end of the experiment, and compared with the other two lots made the greatest increase in weight.

(3). Lot III (corn meal, unsoaked) stood about intermediate.

(4) The pigs in lot I during the first month of the experiment consumed more feeds than those in lot III, but from the second month on lot I lagged behind lot III both in amount of feeds consumed and in gains in weight.

Pigs in lot I which received shelled corn, showed, during the greater part of the time, frequent signs of constipation; the feces were hard and dry at times. The pigs on shelled corn passed out a large amount of the corn undigested. The corn used was Native Yellow Flint.

(5). With the exception of pigs 250 and 253 of lot I, the pigs in the three lots remained in good condition and had a fairly steady good appetite. Pig 250 had a good appetite, but remained unthrifty. Pig 253, while apparently in good condition with good appetite throughout the trial, remained the slowest gainer.

Lot II pigs readily consumed their ration; in fact, of the three lots of pigs, they ate the fastest. Lot I ate the slowest. If they were allowed to choose, the pigs in lot I left the shelled corn practically untouched.

The appearance of the three lots was markedly different at the close of the experiment. Lot I pigs looked spare, rangy, and weak-backed. They appeared to be restless, seemingly searching for food, while the pigs in the other two lots were more contented.

Lot II pigs were all in very good condition throughout the experiment, as was shown by their healthy looking eyes and smooth glossy hair.

In condition, lot III pigs were intermediate between lot II and lot I.

On the whole, all the pigs from the beginning until the end of the trial were apparently in good health. None of them was ever sick.

Experiment III: (1) The pigs in experiment III, like the pigs in experiment II, did not eat their meals with relish during the first week of the feeding test.

(2). The pigs receiving the cooked ration ate the fastest. The pigs in lot I (shelled corn, soaked) took the longest to eat their feed.

(3). As the trial progressed, it became evident that the pigs in lot II on shelled corn cooked ration consumed the largest amount of feed of the three lots; this is shown in their weekly feed consumption. Lot III, on soaked ration with the ground corn, consumed more feed than the lot I pigs on soaked shelled corn. There were times during the trial when lot I gained more weight than lot II. This was the period from August 16 to August 30 (see chart 1).

The pigs in lots I and II suffered from constipation at times, lot I the most seriously. Throughout the trial the pigs in these two lots voided undigested corn. Rarely was undigested corn found in the excreta of lot III pigs.

(4). All the pigs, with the exception of pigs 295, 296, and 289 in lot I and 282 in lot II were in good condition at the end of the experiment.

These pigs, although apparently healthy and feeding well, failed to gain in weight as fast as the others under experiment. These pigs at the end of the experiment were thin and lanky; the mucous membrane of the eyes was congested, and the coat rough.

On the whole, the pigs in lot III were in very good condition, low set and plump. They were uniform in size, form, condition, appetite, etc., at the close of the experiment.

DISCUSSION OF RESULTS

Experiment I

It will be noted at once that contrary to the common belief of hog feeders in this country, pigs fed on cooked ration did not make as rapid gains as the pigs receiving uncooked ration. This is clearly shown in table 1 and in chart 1. The lot on uncooked feed made an average daily gain of 0.159 kilogram and the lot on cooked ration 0.106 kilogram, or the uncooked ration was 50 per cent more efficient in making gains than the cooked ration. This result corroborates the experience of hog feeders in America and other places who, as a general rule, advise the feeding of many common feeds in uncooked form.

It was observed that it took a longer time for the lot fed cooked ration to consume their meal, than those on uncooked ration. It is usually expected that cooking improves the palatability and digestibility of feeds, but the fact that in this case the pigs in the lot fed cooked ration did not relish their ration as much as did those on uncooked ration points to the possibility that the ration lost some of its palatability by cooking. It is possible that the lack in relish was due to the presence of copra meal which is very un-

palatable to pigs Using it in limited quantity with the other feeds without cooking they eat it well enough, but it appears that in cooking it with other feeds the rancidity of the copra meal permeates, or kills the flavor of the other feeds. It is also possible that the digestibility of the feeds may have been improved by cooking, but it is also possible that some of the unknown elements (vitamins) of the feeds may have been partly or wholly destroyed by cooking, so that gains made in digestibility by cooking were not sufficient to offset the loss of palatability and vitamins.

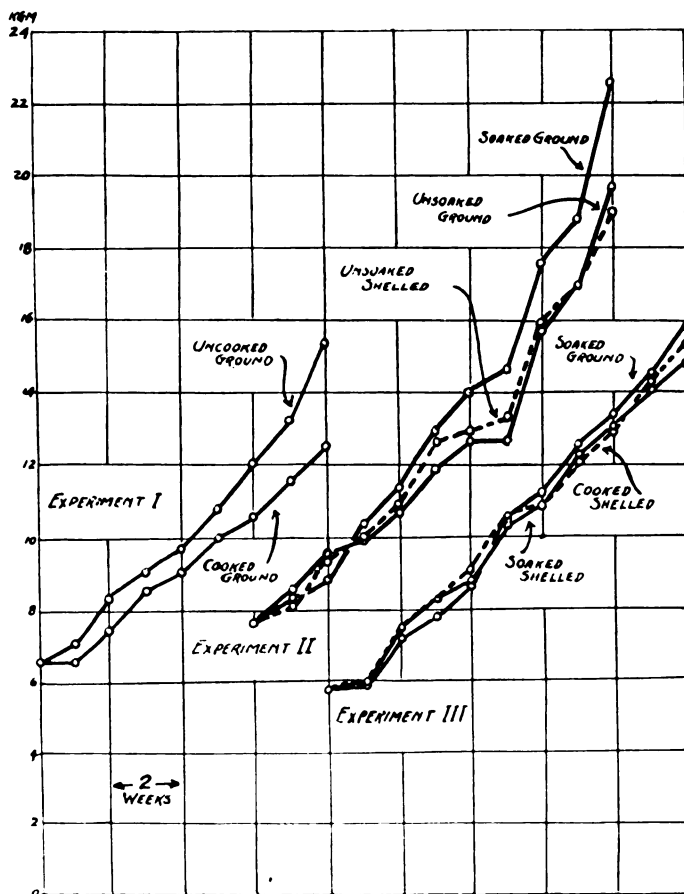


Chart 1.—Showing results in experiments I, II, III.

As may be seen in table 1, the pigs on uncooked ration made a kilogram gain in weight on 4 kilograms ration as against 4.7 kilograms ration required by the pigs on cooked ration.

The pigs on uncooked ration, in lot I were never off feed throughout the experiment. On the other hand, lot II pigs on the cooked ration sometimes could not consume all the feed usually allowed them at feeding time. In other words, they had capricious appetites.

Experiment II

It may be observed in table 2 that lot II pigs on soaked ground corn ration made the most satisfactory gains, followed by lot III pigs on unsoaked ground corn ration, with lot I on unsoaked shelled corn the least satisfactory.

Comparing the ration of lot II which gave the best and lot II the second best results it will be noted that the only difference between them is that the ration for lot II was soaked in water from 10 to 14 hours before it was given to the animals, while the ration of lot III was given to the animals immediately after a like amount of water, as used in the ration of lot II, was added. This one point of difference in the preparation of the ration seemed to be sufficient to cause a marked difference in results in favor of soaking.

The ration of lot I which gave the poorest results differs from the ration of lot III only in the preparation of corn. The rations were both unsoaked, but the corn in lot I was shelled corn, and in lot III, ground corn. The results show that the effect of grinding corn (Native Yellow Flint) for growing pigs (weanlings) is increased in the rate of gains, better health of the animals, and economy of gains.

The ration of lot II, which proved the best, differs from that of lot I, the one that gave the poorest, in two points; namely, it is *soaked* and the corn is *ground*. These two differences were sufficiently important to cause a wide margin in results in favor of soaking and grinding.

Table 2 shows that lot II (ration, soaked and ground) made an average daily gain of 0.21 kilogram live weight; lot III (ration, unsoaked and ground), 0.17 kilogram; and lot I (ration, unsoaked and shelled), 0.16 kilogram. Lot II required 3.1 kilograms, lot III, 3.6 kilograms, and lot I, 3.8 kilograms of feeds to make a kilogram gain.

Soaking and not soaking as shown above made quite a difference in the results, although there is practically no difference between the two in so far as expense and labor in their preparation is concerned.

In soaking the ration there followed an increase in the amount of feeds consumed, and a decrease in the amount of feeds required per unit of gain which goes to show that soaking may have improved the digestibility and palatability of the feeds. It is easy to see that soaking improves digestibility. In cooking, there is the possibility of decreasing the palatability of the ration owing to the presence of rancid oil in copra meal which mixes more or less intimately with the other feeds. In soaking, the possibility of diffusing the flavor of the rancid oil in copra meal is not so great as in the boiling and stirring in the process of cooking. Instead, an actual dilution takes place as the rancid oil is but a small part of a ration which consists largely of palatable constituents. Soaking makes the concentrates more succulent as evidenced by the fact that all the lots on soaked rations suffered from little or no constipation.

Experiment III

In this experiment the soaked ground ration which gave the best results in experiment II is included to compare it with soaked shelled corn and cooked shelled corn rations of this trial.

Table 3 shows that soaked ground corn ration is the best of the three preparations on trial. The pigs on soaked ground corn made an average daily gain of 0.15 kilogram as against 0.14 kilogram from cooked shelled and 0.13 kilogram from soaked shelled rations. To make a kilogram gain, the lot fed soaked ground corn required 3.15 kilograms of feed, the lot fed cooked shelled corn, 3.42 kilograms, and lot fed soaked shelled corn, 3.48 kilograms of rations.

The difference in the results among the three lots was not as marked as between the lots in experiment II. It may also be noted that in this instance cooked ration gave slightly better results than soaked shelled ration. The only way to account for this small difference in results obtained from cooked ration and from soaked ration is that the pigs in this experiment had access to more grass pasture than those on cooked ration in experiment I. The pigs in this experiment had access to good grass pasture the greater part of the trial period. It is more than likely that the deficiencies of the cooked shelled and soaked shelled rations incident to their preparation may have been made up to some degree by grazing.

CONCLUSIONS

1. It is not advisable to cook the ration for growing pigs, particularly for pigs on dry lot and for long periods of feeding. It is not only uneconomical but distinctly harmful.
2. It is advisable to soak the ration for growing pigs, particularly those on dry lot and on limited pasture.
3. Corn, particularly corn of the Flint variety, should be ground before feeding it to growing pigs.
4. A ration soaked with the corn ground gave the best results of all of the preparations tried in these experiments.

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TABLE 1

Showing summary of results of each lot in experiment I

	LOT I UNCOOKED RATION CONSISTING OF:		LOT II COOKED RATION CONSISTING OF:	
	CORN (GROUND). 20 PARTS		CORN (GROUND). 20 PARTS	
	RICE BRAN. 60	"	RICE BRAN. 60	"
	COPRA MEAL. 15	"	COPRA MEAL. 15	"
	DRIED SHRIMPS. . 5	"	DRIED SHRIMPS. . 5	"
Number of pigs.....	9		9	
Duration of experiment.....	55 days		55 days	
Total initial weight.....	59 kgm.		59 kgm.	
Average initial weight.....	6.56	kgm.	6.56	kgm.
Total final weight.....	137.8	"	111.4	"
Average final weight.....	15.31	"	12.38	"
Total gain.....	78.8	"	52.4	"
Average gain per pig.....	8.755	"	5.822	"
Average daily gain per pig.....	0.159	"	0.106	"
Grain consumed:				
Corn.....	63.64	kgm.	49.44	kgm.
Rice bran.....	190.93	"	148.31	"
Copra meal.....	50.90	"	39.54	"
Dried shrimps.....	12.73	"	9.89	"
Total grain feed consumed.....	318.22	"	247.18	"
Cost of grain consumed:				
Corn @ ₱0.0854 per kilogram.....	₱ 5.44		₱ 4.22	
Rice bran @ ₱0.060 per kilogram.....	₱11.46		₱ 8.90	
Copra meal @ ₱0.035 per kilogram.....	₱ 1.78		₱ 1.38	
Dried shrimps @ ₱0.24 per kilogram...	₱ 3.06		₱ 2.36	
Total cost of grain consumed.....	₱21.74		₱16.86	
Average daily grain per pig.....	0.6429	kgm.	0.4993	kgm.
Grain feed consumed per kilogram gain....	4.0383	"	4.7171	"
Cost of grain to produce 1 kilogram gain..	₱ 0.2758		₱ 0.3217	
Grain feed consumed per 100 kilogram gain.	403.83	kgm.	471.71	kgm.
Cost of grain to produce 100 kilogram gain..	₱27.58		₱32.17	

TABLE 2

Showing summary of results of each lot in experiment II

	LOT I	LOT II	LOT III
	UNSOAKED RATION SISTING OF:	UNSOAKED RATION CONSISTING OF:	UNSOAKED RATION CON- SISTING OF:
	CORN (SHELLED), 20 PARTS RICE BRAN..... 60 COPRA MEAL.... 15 DRIED SHRIMPS.. 5	CORN (GROUND), 20 PARTS RICE BRAN..... 60 COPRA MEAL.... 15 DRIED SHRIMPS.. 5	CORN (GROUND), 20 PARTS RICE BRAN..... 60 COPRA MEAL.... 15 DRIED SHRIMPS.. 5
Number of pigs.....	5	5	5
Duration of experiment.....	70 days	70 days	70 days
Total initial weight.....	38.17 kgm.	38.15 kgm.	38.12 kgm.
Average initial weight.....	7.63	7.63	7.624
Total final weight.....	94.8	112.8	98.1
Average final weight.....	18.96	22.56	19.62
Total gain.....	56.63	74.65	59.98
Average gain per pig.....	11.326	14.93	11.996
Average daily gain per pig.....	0.1618	0.2132	0.1713
Grain consumed:			
Corn.....	42.56 kgm.	46.38 kgm.	43.16 kgm.
Rice bran.....	127.68	139.14	129.48
Copra meal.....	31.92	34.785	32.37
Dried shrimps.....	10.64	11.595	10.79
Total grain feed consumed.....	212.80	231.9	215.8
Cost of grain consumed:			
Corn @ P0.085 per kilogram.....	P 3.62	P 3.94	P 3.67
Rice bran @ P0.060 per kilogram.....	P 7.66	P 8.35	P 7.77
Copra meal @ P0.035 per kilogram.....	P 1.12	P 1.22	P 1.13
Dried shrimps @ P0.24 per kilogram.....	P 2.55	P 2.78	P 2.59
Total cost of grain consumed.....	P14.95	P16.29	P15.16
Average daily grain per pig.....	0.608 kgm.	0.662 kgm.	0.617 kgm.
Grain feed consumed per kilogram gain.....	3.757	3.106	3.597
Cost of grain to produce 1 kilogram of gain.....	P 0.264	P 0.218	P 0.252
Grain feed consumed per 100 kilogram gain.....	375.77 kgm.	310.60 kgm.	359.70 kgm.
Cost of grain to produce 100 kilogram gain.....	P26.40	P21.89	P25.27

TABLE 3
Showing summary of results of each lot in experiment III

	LOT I	LOT II	LOT III
	SOAKED RATION CONSISTING OF:	COOKED RATION CONSISTING OF:	SOAKED RATION CONSISTING OF:
	CORN (SHELLED). 20 PARTS RICE BRAN..... 60 " COPRA MEAL..... 15 " DRIED SHRIMPS.. 5 "	CORN (SHELLED). 20 PARTS RICE BRAN..... 60 " COPRA MEAL..... 15 " DRIED SHRIMPS.. 5 "	CORN (GROUND). 20 PARTS RICE BRAN..... 60 " COPRA MEAL..... 15 " DRIED SHRIMPS.. 5 "
Number of pigs.....	5	5	5
Duration of experiment.....	70 days	70 days	70 days
Total initial weight.....	28.74 kgm.	28.77 kgm.	28.37 kgm.
Average initial weight.....	5.748 "	5.74 "	5.674 "
Total final weight.....	73.7 "	76.6 "	79.60 "

EXPERIMENT NO.	DURATION	AGE OF PIGS
		months
I	July 5, 1926 to Aug. 29, 1926	3½
II	May 1, 1927 to July 10, 1927	3½
III	Sept. 4, 1927 to Nov. 13, 1927	3

THE PHILIPPINE AGRICULTURIST

TABLE 4

Showing summary of results of experiments I, II, and III

LOT NO.	RATION	NUMBER OF PIGS	AVERAGE INITIAL WEIGHT OF PIGS	NUMBER OF DAYS	TOTAL GAIN	AVERAGE DAILY GAIN PER PIG	GRAIN TO PRODUCE 1 KGM. GAIN	COST OF CONCENTRATE PER 100 KGM. GAIN
	(Uncooked)		kgm.		kgm.	kgm.	kgm.	per 100
I	Corn meal...20 parts Rice bran....60 " Copra meal...15 " Dried shrimps. 5 "	9	6.56	55	78.8	0.159	4.0383	27.58
II	(Cooked) Corn.....20 parts Rice bran....60 " Copra meal...15 " Dried shrimps. 5 "	9	6.56	55	52.4	0.106	4.7171	32.17
I	(Unsoaked) Shelled corn...20 parts Rice bran....60 " Copra meal...15 " Dried shrimps. 5 "	5	7.634	70	56.63	0.1618	3.757	26.40
II	(Soaked) Corn meal...20 parts Rice bran....60 " Copra meal...15 " Dried shrimps. 5 "	5	7.63	70	74.65	0.2132	3.106	21.89
III	(Unsoaked) Corn meal...20 parts Rice bran....60 " Copra meal...15 " Dried shrimps. 5 "	5	7.624	70	59.98	0.1713	3.597	25.27
I	(Soaked) Shelled corn...20 parts Rice bran....60 " Copra meal...15 " Dried shrimps. 5 "	5	5.748	70	44.96	0.1284	3.476	23.26
II	(Cooked) Shelled corn...20 parts Rice bran....60 " Copra meal...15 " Dried shrimps. 5 "	5	5.754	70	47.73	0.1363	3.423	23.00
III	(Soaked) Corn meal...20 parts Rice bran....60 " Copra meal...15 " Dried shrimps. 5 "	5	5.674	70	51.23	0.1462	3.152	21.00

AN AGE OF INSECTS, NOT OF MAN: SOME NOTES ON THE FOURTH INTERNATIONAL CONGRESS OF ENTOMOLOGY¹

FRANCISCO M. SACAY

"It is a startling thought to egotistical humanity that this is not the age of man: it is the age of insects; that man is a newcomer; that he is as yet an experiment, and that the same may be said of his immediate and in fact of his very remote ancestors—of the whole vertebrate series." Thus runs a statement in the keynote address by Dr. Leland O. Howard, when he opened the Fourth International Congress of Entomology held at Cornell University between August 12 and 18, 1928.

This congress is considered as one of the largest entomological congresses ever assembled, and was attended by about 600 of the most distinguished entomologists from all the states in the United States and thirty foreign countries.

The opening speeches were delivered by Dean A. R. Mann of the New York State College of Agriculture, and Dean W. A. Hammond of the University Faculty, both of whom welcomed the guests; and by Doctor Howard, as noted above. Doctor Howard was for many years the Chief of the United States Bureau of Entomology. He is honorary curator of the Department of Insects, U. S. National Museum, and president of the Fourth International Congress of Entomology. He also has the distinction of being the first American to finish the course in entomology which was established by Prof. J. H. Comstock in Cornell University in 1872.

In connection with his reference to this age as being an age of insects, he cited the following opinion of W. C. Allee, professor of zoölogy: "In time this may become the age of man, the most highly developed mentally of the vertebrates, but at present he is only beginning to dispute the ascendancy of his rivals, the highly specialized insects crowning the Arthropod series." Man undoubtedly is greatly outnumbered by insects, for entomologists believe that "there are immeasurable millions of insects, and that estimates of the possible number of species run from five to twenty-five millions."

¹General contribution from the College of Agriculture No. 212.

These interesting and valuable notes were sent the editor by Mr. Francisco M. Sacay, B. S. '27. Mr. Sacay, now a U. P. Fellow in Cornell University, majoring in Rural Education, was formerly an instructor in Rural Economics in this College. It is gratifying to receive this evidence of interest in this College from a Fellow and to know that he is using his opportunities for lengthening his mental diameter in other lines than his chosen subject. Graduate students are too apt to become men with "single track" minds.

Known species of fleas, number 800

Dr. Karl Jordan of the Zoölogical Museum of Tring, England, who read a paper on the problems of distribution and variation of North American fleas, estimated that the total number of species of fleas occurring in the United States and Canada is over 200, and taking all parts of the world, 800. Said Doctor Jordan: "I don't think we know more than one-third of the species of fleas actually in existence."

650,000 distinct species of insects known

Professor Filipo Silvestri of Italy, in his paper, stated that some 650,000 distinct species of insects are known to entomology, and ventured the opinion that at least five times as many actually exist. He also mentioned the contribution of applied entomology and the valuable information it gives to humanity "through studies of mosquitoes, flies, fleas, and insects injurious to plants." The yearly losses caused by grasshoppers in many countries is enormous, he said, and he emphasized the importance of a more careful study of this insect and its parasite.

Tiny wasp, an ally of man against cane borer

In a paper on "The Egg Parasite" by W. E. Hinds and H. Spencer, entomologists in the Louisiana Experiment Station, the importance of a tiny wasp as an ally of man in his fight against the sugar cane borer was discussed. These men find it practicable to breed these wasps in the laboratory during the winter season "thus securing a large supply for field colonization work on cane borer eggs during the first half of the season." Their experiments indicate strongly "that there is a definite possibility of starting the field attack on the cane borer, or some early appearing host eggs, several weeks earlier in colonized fields than natural parasitism will appear in uncolonized areas".

Employing weed eaters

Experiments on the employment of insects in the extermination of pest plants and weeds were described by Dr. A. D. Imms, chief entomologist at the Rothamstead Experiment Station, England. He has been working on the control of pest plants by introduction of insect enemies of these plants. However, this is not so simple as it appears to be, for imported insects may change their "diet" in a new place and, instead, becomes pests of crops which they might find more "savory". Furthermore, if an insect is to do its work successfully, it must be free from its natural parasites.

Dr. R. J. Tillyard, entomologist from Australia, had made similar studies and found that this method of control—which is termed 'biological control'—is the most practicable means of dealing with large areas in a sparsely populated country.

Ants valuable help

Professor H. A. Eidman, of the University of Munich, who discussed the economic value of ants in relation to German forests, said that few species of ants are really injurious, and that their utility is much greater than their destruction, for they keep the forest in a sound state, especially the red hill ant (*Formica rufa* and its race). "Being an insect of prey it feeds almost entirely on other insects which it usually seizes alive according to my experience gathered in the hunting grounds of the colonies of red hill ants." Professor Eidman calculated that about two million insects were destroyed in one summer by a large colony of ants. Their importance was clearly shown during the period of the great pine moth pest of Northern Germany in 1924, when about 375,000 acres of forest were destroyed. "Whenever there had been ant hills the forest remained uninjured to a greater or smaller extent," he explained, and "no ant hills existed in the vicinity of the forest which was ruined."

Insects of the upper air

A study of insects of the upper air was made by Dr. E. P. Felt of the Bartlett Research Laboratories of Stanford, Connecticut, by collecting insects on the tops of high buildings in large cities, and in places which are not the natural habitat of such species. His conclusion was that this unusual distribution of insects could be explained as due to air currents rather than to purposive migration, but this conclusion he said, has not been established beyond doubt.

Tries bites of poisonous insects

Dr. W. J. Baerg, of the University of Arkansas, whose interest lies in the study of poisonous and so-called deadly insects, was referred to by one of his friends in the congress as "having been bitten by more 'fatal' insects than any other entomologist." Doctor Baerg found that the belief that the tarantula often found in bunches of bananas is deadly poisonous is not true, for "most or nearly all tarantulas are harmless". The same is true of many members of the scorpion family, although the Durango species has been the cause of many deaths, and it generally proved fatal to guinea pigs and rabbits. In order to observe the effects on man he took a small dose of the poison, but "experienced nothing worse than a 'severe' pain."

Species and evolution

Dr. Walter Horn of Berlin, in the course of his talk, asked whether the existence of species is a negation of evolution. His own answer was: "No. Species serve only as rests, as pauses in the respiration of evolution. Do not forget that the final clearing up of the notion of species would be nothing else but finding not only the actual tree of life, not only its root, but even its seed-kernel."

Foreign insect invaders

The need for restriction against entry of foreign plants as a means of preventing the entrance of new and dangerous insect pests was discussed by Dr. C. L. Marlatt of the Bureau of Entomology, Washington, D. C. He said that millions of dollars are being spent to control the insect pests which have entered the United States from foreign countries, and that losses caused by them run into billions of dollars. Some of the foreign invaders cited by him are the Hessian fly, the San José scale, the boll weevil, the chestnut blight, the Oriental fruit worm, the Japanese beetle, the white pine rust, and the European corn borer. For the control of the European corn borer alone Congress appropriated \$10,000,000 this year.

Importance of congress

Dean Mann emphasized the importance of such contact among workers in the same and related fields as the "surest guarantee of reliable progress and the greatest incentive to superior achievement"; that "progress will be accelerated by an increasingly close and intimate fellowship among men of science and the integration of minds engaged in related fields of inquiry."

Dean Hammond regards such congresses as an important phase of modern science and letters because "scholars come into living contact, and at times into stimulating intellectual conflict, with one another", and that the free and unhampered exchange of ideas and opinions promote increasing progress of inquiry.

ABSTRACT¹

The effect of borders in farm crops experiments. JUAN PEGINA. (*Thesis presented for graduation, 1928, from the College of Agriculture No. 274; Experiment Station contribution No. 562*).—The main object of this experiment was to find out “the effect of borders in farm crops experiments”. The materials used for this piece of investigation were soybean, variety Ami; corn, variety Calauan Yellow Flint; upland rice, variety Cañabongbong; and lowland rice, variety Bal-latini.

With corn, dry and wet season crops were planted. With the other crops there was only one planting. For upland rice, the drill method was employed, and for lowland rice the ordinary method. With soybean the seeds were planted in plots of 11×5 meters.

The author obtained the following results:

With corn, for both the rainy and the dry season crops, no definite conclusions could be drawn as to border effect. In the rainy season corn crop the average production of ears per hill in the first two border rows were: 261.50 ± 0.364 , and 272.17 ± 0.451 grams, respectively; the average yields for the next four rows were: 253.26 ± 0.305 , 164.24 ± 0.360 , 206.67 ± 0.189 , and 207.45 ± 0.284 grams, respectively. In the dry season corn crop the average production of ears per hill from the five border rows were: 269.68 ± 0.216 , 409.01 ± 0.218 , 370.26 ± 0.165 , 409.45 ± 0.153 , and 409.22 ± 0.186 grams, respectively.

With the upland rice no definite conclusion could be drawn as to border effect. The average yields of panicles per one-meter section from the first six rows were: 74.41 ± 0.237 , 60.30 ± 0.256 , 18.22 ± 0.260 , 69.17 ± 0.201 , 67.90 ± 0.167 , and 71.63 ± 0.297 grams, respectively. With the lowland rice, clean border had a slight effect on the yield of panicles. The yield of panicles per hill from the first border row was 13.51 ± 0.267 grams. The average yields of panicles per hill in the next four border rows were: 10.72 ± 0.847 , 9.59 ± 0.226 , 12.49 ± 0.314 and 10.06 ± 0.283 grams, respectively.

With soybean, the border effect on the height of plants was found significant in the first border row, being 42.12 ± 0.245 centimeters; the heights of plants in the next four border rows were: 29.94 ± 0.380 , 30.46 ± 0.241 , 34.12 ± 0.188 and 33.94 ± 0.175 centimeters, respectively.

—Abstract by Clemente E. Yango.

¹ Abstract prepared as part of required theme work in English 6, College of Agriculture.

EXTENSION DIVISION NOTES

College Extension Work in Visayas

Early in September Mr. Moises M. Kalaw, Extension Assistant of the College of Agriculture, went to the Visayan Islands to direct the construction of two copra driers. One, a 6,000-nut-a-day capacity for Mr. Teofilo Mejia's hacienda at Puerto Bello, Ormoc, Leyte and one for Mr. Espiridion Villegas' hacienda at Tabon, Vallehermoso, Oriental Negros. Mr. Kalaw stopped at Guimaras Island, Iloilo to examine the copra drier which was built in May, 1927 for the Cabano Estate by Mr. P. Zimmermann, Plantation Manager, following the direction of the College Circular No. 11 on the "New College Copra Drier".

Mr. Kalaw reported that he found this copra drier working in perfect order, and it is considered to have passed the experimental stage. The people concerned in the Cabano Estate which has a plantation of 280,000 coconuts are satisfied with the drier. A complete report of its working will be given later. In the course of the construction of the drier at Puerto Bello, people from different parts of the province, especially from the Leyte Farm School at Baybay, came to watch the work and learn of the structure by actual inspection.

The Eighth Agricultural Congress

The College Extension representative in semi-official capacity attended the Agricultural Congress the last two days of its five-day session (September 11-15). Two resolutions were presented by him to the Congress; they were:

1. Resolution to the effect that the Legislature be petitioned to increase the appropriation devoted to the establishment of agricultural schools so as to enable every province in the Islands to establish a school for vocational instruction in agriculture, commerce, and industry;
2. Resolution urging the Agricultural Congress to take definite steps in organizing a separate farmers' association for each of the main agricultural industries of the Islands, such as rice, coconuts, abaca, tobacco, which call for a collective effort on the part of their respective growers.

The aim of the first resolution is to develop in each province a farm agricultural school or another vocational type of school that will best meet the particular need of that province for boys and girls especially trained in practical work along the agricultural and industrial lines representing the major occupations of the people in the province. It is a plan that seeks for more or less exclusive training of the students from the different municipalities of the province in its principal industries in agriculture or otherwise. To this end, stress will be laid on such industries as represent the dominant occupations of the people in the province. Thus, if abaca, coconut, sugar cane, tobacco or animal industry is the principal means of livelihood and the main source of income of the people, the course of study should be so framed

that the strength of the course would lie in this direction. The academic and general part of the instruction, while important and should receive a proper share of attention, should be subsidiary to the main course. Thus if the local need of the province for trained youth in its own main industries be supplied the agricultural and economic development of the province would be more effectively served educationally. The establishment of such a type of school as rapidly as possible in every province will place before the boys and girls an equal opportunity for training for the industries in their communities.

The second resolution has for its aim the development among the farmers of the spirit of association and co-operation so that they may in time reap the benefit from acting together in the business of producing and marketing their crops and improving agricultural industry in all its aspects. In this connection the Philippine Sugar Planters' Association and the Cattle Producers' Association are examples. While these new associations do not have an established connection with the Agricultural Congress, a number of their members are members of this body. Now, if the associations for our different staple crops were formed by the initiative taken in the convention of the Agricultural Congress, this body may be made the federation body of the smaller organizations. Such a plan if effected would lend a new vigor to the Philippine Agricultural Congress.

Liberalization of Philippine Land Law

The Agricultural Congress was vigorously opposed to changes in our land law. The consensus of opinion was that the acreage of our unoccupied public land is too limited to justify the increase of the area granted corporations under the provisions of the present land law. Practically all were agreed that the pressing and urgent need is to facilitate the occupation of our unoccupied public land by homesteaders through insuring the applicants that their homesteads on which they file be absolutely free from adverse claims. Further than this, there was no dissenting opinion as to urging the government to speed up the issuance of Torrens titles to homesteaders who have duly complied with the requirements of the law. It was practically concluded that the old principle that land uniformly distributed among the people, small land owners forming the vast majority, is the surest basis and guaranty for stability in all orders of life.

This discussion was important for land ownership is the greatest incentive to good farming. But mere land owning does not help a man nor his community unless he keeps his land under cultivation and makes it increasingly productive year after year. Unless the owner of the land attends to his farm business and constantly improves his farming and marketing methods—eventually joining hands with his neighbors and other farmers organized into an association for co-operative efforts—sooner or later he may lose his land by default in the payment of land tax or by unsatisfied obligations.

Herein lies the importance of the initiative of the last Agricultural Congress in undertaking the formation of associations of farmers having a common crop interest.

EXCHANGE NOTES

The millions of dollars invested in the movies and the pleasure of the millions of people who daily attend them is based on chemical impurity in gelatine. This announcement, in effect, was made in a lecture given by Dr. C. E. K. Mees, director of the Research Laboratory of the Eastman Kodak Company. "It has recently been found," said Dr. Mees, "that the sensitiveness of films is not due to the grains of silver bromide only, but is in some way connected with the presence on those grains of specks of some other substance, and the Kodak Research Laboratories after a long and careful study have found that these specks are produced by an accidental impurity present in the gelatine. This impurity is derived from the plants eaten by the animals from whose skins the gelatine is made. There is only a very small amount of it, but it is a compound which contains sulphur, and when the gelatine is used for making the film, the sulphur reacts with silver bromide and produces specks of silver sulphide on the crystals. In some way or other these specks increase the effectiveness of the light to which the film is exposed in the camera and enable the light to change the silver bromide so as to form a trace of metallic silver. Then this silver acts during development as a nucleus on which more silver can deposit by the chemical process until the whole of the silver bromide crystal is turned into silver. Each of the original crystals of the film therefore, after exposure to light, becomes a grain of silver in the developed film, and it is of these grains of silver that the image projected on the screen is exposed.

—*Science.*

Unless the farm is managed as a business, the yield of every cow recorded, the low producers eliminated, and only the big yielders and their progeny kept, the natural advantages of good fertile land, large rainfall, and magnificent fresh-water streams cannot be put to maximum use.

—*The Agricultural Gazette of N. S. W.*

Handkerchief imports into Manchuria are valued at about \$50,000 a year. Japan and Great Britain are the chief suppliers. The type sold in largest quantities are cotton handkerchiefs with drawn-thread hem.

—*Commerce Reports (U. S. A.)*

It costs sixty cents to grow a bushel of corn in Iowa according to the average found on ninety-three farms where corn production cost was given

special study by agricultural economists of Iowa State College, working in co-operation with the farmers. These farms are probably above the average, so the actual state average would be somewhat higher, the economists say.

—*The Farmer and Stockman.*

Cornell University has now in progress a fellowship devoted to the study of the use of dry skim milk and ice cream. Preliminary results are encouraging and it is expected that findings will lead to greater use of dried milk, thus creating a wider market for this comparatively new product.

—*Butter and Cheese Journal.*

Toe picking and feather picking among chicks does not necessarily indicate a deficiency in the ration, but often become a matter of habit, according to Roy E. Roberts of Purdue University.

These vices usually start by a toenail or feather being pulled out accidentally. The blood attracts the other chicks and they start picking. This soon leads to cannibalism and several chicks may be seriously injured or even killed. The troubles are more apt to develop in a crowded brooder house.

The most satisfactory means of preventing and controlling the trouble is to avoid crowding the chicks, and by getting them out of doors as soon as possible. If chicks must be confined indoors, care should be taken not to crowd them. Keep the mash hoppers full, and give them things to keep them busy such as pieces of green sod. When chicks start picking one another, remove the injured ones at once.

—*The Prairie Farmer* (Illinois).

It is gratifying to report from time to time the steady advancement of the control of tuberculosis in this country. Millions of dollars and months and years of arduous labor are being put into this work. At times it would seem that very little progress is being made, yet in looking back over the past year or two it will be found that real progress has been accomplished. . . . A fourth survey of the country recently completed indicates that bovine tuberculosis now affects only about two per cent of the animals as against four per cent at the time of the first survey in 1922.

—*Guernsey Breeders' Journal.*

The most successful annual meeting yet held by the Canadian Seed Grower's Association came to a close at the Chateau Frontenac on June 16th. The reports of the directors showed an increasing demand by farmers

for registered seed, the highest grade of pure seed that can be produced and which is produced by members of the association.

—*The Journal of Agriculture and Horticulture.*

An increase of one and one-half to three times normal production has been obtained by the United States department of agriculture when garden land was covered with heavy asphalt saturated paper. This is an adaptation of the practice commonly used in the pineapple fields of Hawaii.

The use of paper mulch, besides increasing yields, eliminates all weeds between rows, facilitates weeding between plants in the row, and does away with the necessity of cultivation. In certain crops there is a marked hastening of maturity, and an increase in germination. The crop is also improved in size, quality and cleanliness.

—*Successful Farming.*

COLLEGE AND ALUMNI NOTES

Professor Michael F. Guyer, Head of the Department of Zoölogy of the University of Wisconsin was a Campus visitor on October 9, 1928. Professor Guyer was accompanied by Dr. Serafin Macaraig of the College of Liberal Arts of the University of the Philippines. Professor Guyer is the author of two popular textbooks, *Being Well Born*, an introductory textbook to the study of Eugenics and *Laboratory Technique for Biology Students*. The Acting Dean, a former student of Professor Guyer, showed him around the Campus. He was particularly interested in the departments of Zoölogy, Parasitology, and Animal Husbandry.

Miss Margaret Wilson formerly of the staff of the Department of English sent two boxes of books for use in the department. Also seventy-five phonograph records to be distributed among the Molawin Hall, College Lunch and Forget-me-not restaurants and the Forest School. The recipients of these much needed books and records are grateful for Miss Wilson's generous kindness.

Under the auspices of the Junior Agricultural Congress, Mr. Faustino Reyes, Chief of the Division of Public Lands, Bureau of Lands, spoke at the Student Body Convocation in September on "How students and alumni of the College of Agriculture may acquire land under the provisions of Public Land Laws." The students were much benefited, as the subject was admirably presented.

In the morning of Sunday, October 1, 1928, Dr. R. B. Espino, Head, Department of Plant Physiology, gave a one-hour lecture on botany to students enrolled in biology in the Columbian Institute.

In the afternoon of the same day Doctor Espino gave a lecture to students taking botany in the College of Education of the University of Santo Tomas.

Cards have been received from the United States announcing the marriage of Miss Marcia Whipple and Lt. Elmo Shingle of the United States Army. Miss Whipple was formerly on the staff of the Department of English.

The Department of Animal Husbandry just completed the construction of a silo. This is, so far as the department knows, the second silo constructed in the Philippines, the first one being in Alabang. The silo is eight feet in diameter and twenty-four feet high and has a capacity of about twenty-two tons. About thirteen tons of corn fodder was put in as an experimental filling on September 18, 1928.

At the suggestion of several resident members of the Sigma Xi Society, an honorary scientific fraternity in the United States, a meeting was held in the office of Dr. N. B. Mendiola on September 11, 1928. It was unanimously decided in this meeting to organize a local Sigma Xi Club. Steps are now being taken to affiliate this club with the central office of the society in New York. Dr. N. B. Mendiola was elected temporary president of the club, and Dr. F. M. Fronda, temporary secretary.

The Sigma Xi members who were present are:

Dr. F. M. Fronda	Cornell (Alpha) Chapter
Dr. A. K. Gomez	Cornell (Alpha) Chapter
Dr. L. G. Gonzalez	Cornell (Alpha) Chapter
Dr. V. G. Lava	Columbia Chapter
Dr. N. B. Mendiola	Cornell (Alpha) Chapter
Dr. G. O. Ocfemia	Wisconsin Chapter
Dr. M. A. Tubangui	Cornell (Alpha) Chapter
Dr. D. Villadolid	Stanford Chapter

The other residents Sigma Xi members who were not able to be present at the meeting are:

Dr. F. O. Santos	Yale Chapter
Dr. M. D. Sumulong	Michigan Chapter
Dr. T. Vilar	Illinois Chapter
Dr. R. L. Pendleton	California Chapter

The Los Baños Biological Club held its thirty-eighth scientific meeting in the Auditorium of the College of Agriculture on October 4, 1928.

The papers read and discussed were:

“A promising cassava grater for the farm”

by Mr. Zosimo Montemayor.

“Accuracy in the weighing of experimental chickens”

by Dr. F. M. Fronda.

“Studies on the factors influencing the distribution of hookworm infestations in the Philippines.”

(Read by Doctor Tubangui).

by Drs. M. A. Tubangui and R. Q. Javier.

The last number of *The Makiling Echo*, quarterly journal published by the School of Forestry contains articles on “Moisture Content of Mangrove Barks,” “Agricultural Settlement and its Solutions” and other interesting shorter articles and notes.

Mr. Alejandro B. Catambay, who was graduated from the College of Agriculture with the degree of B. Agr. in 1924 and B. S. in 1925, and from the University of California in May, 1927 with the degree of M. S. with major in farm machinery was appointed temporary instructor in Agronomy in our College effective August 1, 1928. Mr. Catambay is at present assigned to the division of farm machinery and implements of the Department of Agronomy.

Mr. E. de Bragança Pereira, B. S. '21, writes Doctor Mendiola that he is employed as Agricultural Expert in the Department of Agriculture, Northern Division, Portuguese India.

The tenth anniversary of Loyalty Day, October 10, was ushered in with Loyalty Day Students' Parade. This was followed by review of the Corps of Cadets by His Excellency, the Governor General. At the end of review Governor General Stimson addressed the Cadets.

The program at the band stand with Lt. Amado Martelino, Chairman of Committee of arrangements, presiding, opened with the singing “Third Battalion March” by the Cadet Corps. Mr. Basilio Viado, a National Guard Veteran, spoke briefly. A Cadet quartet sang a group of “Old Time Songs.” Major Gilmore, commander of U. P. Cadets, gave a brief address. This was followed by the singing of “Varsity March” by the students. President Palma gave the principal address of the day.

Regent Zamora presented a medal to Campus Guard Pablo Estubesa and to member of family of Guard Joaquin Onglao who was killed by the

bandits in the recent attempts to rob the College safe. Guard Estubesa was badly wounded. These medals were donated by Regent Zamora, who was a member of the first class graduated from this College. The College song "Hail College Dear" by students closed the program.

The faculty were hosts at a luncheon in Molawin Hall to the guests of the day.

In the afternoon members of the faculty and Alumni put up a good fight against the Seniors and Juniors in baseball, volley ball, soccer football, cage ball and relays.

A free movie at the Auditorium under the auspices of the Military Science Department closed the "perfect day."

A new feature of the day's celebration was the Student Parade. This was initiated by the Department of English and carried out under its direction, assisted by the Department of Military Science.

College organizations each with some distinguishing feature in dress and with the Cadets in platoons formed the procession. The order of march was:

Order of March

1. Forest School Platoon Cadets
2. National Guard Veterans
3. Cadets Company I, Platoon 1
4. Senior Class
5. Whangdoodles
6. Tobacco Junior Planters' Association
7. Cadets Company I, Platoon 2
8. Screeching Owls
9. Catholic Truth Society
10. Cadets Company I, Platoon 3
11. Associated Women Students
12. Cadets Company K, Platoon 1
13. Andelros Club and Association of Sugar Technologists
14. Syncopating Sillies
15. Cadets Company K, Platoon 2
16. Self-Made Man Association
17. Cadets Company K, Platoon 3
18. Ranchers' Club
19. The Mimics
20. Junior Agricultural Congress
21. Cadets Company L, Platoon 1
22. Howling Hooligans
23. Aggie Pensionado Club
24. Cadets Company L, Platoon 2
25. The Four Horsemen
26. The Seedlings
27. Cadets Company L, Platoon 3

Each organization merited the praise it received. Space does not permit descriptive comments. The Whangdoodles, the Syncopating

Sillies (with ukeleles), the Four Horsemen masked, mounted on poles with realistic horse's heads (all these for fun); the Screeching Owls and the Howling Hooligans (groups to lead the singing) were arranged and costumed by the Department of English. They are *not* College organizations.

The parade marched first to the Auditorium, the scene of the National Guard enlistment in 1918. Here the eight National Guard Veterans who under escort led the parade, formed in front the building. A volley was fired in salute and the buglers blew "Call to Colors." The route of march led past department buildings which were saluted, then across Molawin Creek to the Athletic Field. Here the procession passed in review before and salaamed to His Sublime Majesty, King Loyadpar. His Majesty, Felix Sarao, robed in royal purple—his scepter a long shining bolo, sat in royal splendor under a canopy upheld by bearers, the court fanners kept him cool with Filipino brooms, guards in shining coats of mail protected him. Trumpeters announced each section of parade—while all the time the court jester, Salvador Sales made merry.

There was a fine rollicking student spirit in it all. The King summoned the Amah (a whangdoodle) to bring his infant (in a wheelbarrow perambulator) to his throne. In Jove-like tones he proclaimed the child the hope of the country, gave him a shovel saying, "Learn to use this and you will be part of the backbone of your country."

The couple "going to Mindanao in a carabao cart" (Senior Class) were given royal salute. As a finale the King commanded a trumpeter to summon Megaphone High Muck-a-Muck (who directed the singing in marching) to appear before him. With the old time ceremony King Loyadpar, for expert service, knighted the megaphoner, Antonio Flores, "Sir Muck-a-Muck."

It is hoped that the Students' Parade will in the future be a feature—in time *the* feature of Loyalty Day.

ON THE ADVANCEMENT OF SCIENCE BY PUBLISHED PAPERS

Undoubtedly science is kept alive by teaching; and without good teaching, there can be but little discovery. Edison, for instance, when young, possessed and studied Faraday's masterly researches on electricity.

The present writer has been engaged in scientific research for eighteen years or so. He does not pretend, however, to have observed all the following rules, of the importance of which he became cognizant by degrees. The foundation of the co-operative fabric of science and scientific discovery has been built up, by the work of the early "missionaries of science," when research entailed more or less of a martyrdom. It is hoped that we can pass on to posterity this edifice of science, undecayed and even embellished, now that research is a privilege and a giver of prestige. If we do not, the position of science and scientific work may deteriorate without limit.

(1) The truth, and nothing but the truth, but never the whole truth *for publication*. One must omit trivialities. Our scientific magazines are now sometimes more or less packed with never-to-be-utilized details, most of which perhaps would have better rested in the notebook. The penalty for nonobservation of this rule is the, probably now imminent, cessation of publication, except in the form of abstracts.

(2) It is perhaps unethical for a research worker, as for a medical man, to advertise. Plethoric papers, pictures not absolutely necessary, repetitions in different magazines, references mainly to one's own work, and unneeded elaboration or enlargement of figures, seem to partake of the nature of advertising. The penalty for infraction is the introduction of competitive business methods into science as an ideal; instead of the co-operative aims, which have produced such good results in the past.

(3) Mere facts, however new, are often (though not always) of perceptible scientific value only when their discoverer, or some one else, has demonstrated their relations to other facts, or to a theory or hypothesis of value. If they have no such demonstrable relations, they are probably "trifling though true." The penalty is again the ending of magazine publication *in extenso*.

(4) The repetitions and confirmations of a discovery on similar or related material are of sufficient scientific interest to warrant full publication only to a certain degree of repetition. Whether this is ten or a hundred times, the point is at length reached when only the accounts of exceptions to the rule are worth full publication. The penalty is again the flooding of magazines, and the future reduction to abstract publication.

(5) The publication of a working hypothesis by one who has discovered a sufficient amount of relevant fact is welcome, and indeed almost necessary. (A working hypothesis is one that is immediately to be tested.) But a mass of untested hypotheses is readily producible; and may be aimless, except to fill space. A flood of hypotheses, which cannot be immediately tested, may be a brake on the progress of a science. Since it is easier, for many of us, to spin hypotheses than to make discoveries, the penalty for the appreciation and prestige of this form of mental exercise is the partial, or even complete, cessation of experiment.

(6) It is probably unethical to claim credit or priority for an untested hypothesis (mostly for writers in the distant past), to the prejudice of those who have borne the full burden of testing it. A writer who has published, among a number of unworkable hypotheses, one which has subsequently been used as a successful working hypothesis, does not apparently deserve to be cited. Perhaps one should not attach priority to any untested hypothesis, but only to true working hypotheses.

(7) It is generally recognized that, in a serious scientific paper, citations of a genuinely relevant previous work should be complete, so far as they are not known to all readers. Even excessive and pedantic citation is a fault on the right side. But surely much space might be saved by referring to standard numbered annual lists of scientific papers. The penalty for lack of citation is, of course, to leave it doubtful as to how much the writer has himself discovered. It leads also to the isolation of workers or countries. But excessive citations again overload the magazines.

(8) A form of scientific co-operation consists in the sending of separate copies of papers, in not readily accessible magazines, to other interested workers. This has now extended to all magazines, even those accessible to everybody. Stanley Hall regards it as a means of working up a personal following or constituency; in other words, it is now an advertising method. Perhaps as much as anything else, it injures the circulation of the scientific magazines.

These and other similar rules are, of course, well known to, and observed by, many experienced workers.

—NATURE.

Agriculture, more than any other industry today, feels a widespread need of capable, intelligent and clear thinking leaders, such as might be developed from high school students who choose to take an agricultural college course.

—Quarterly of Alpha Zeta.

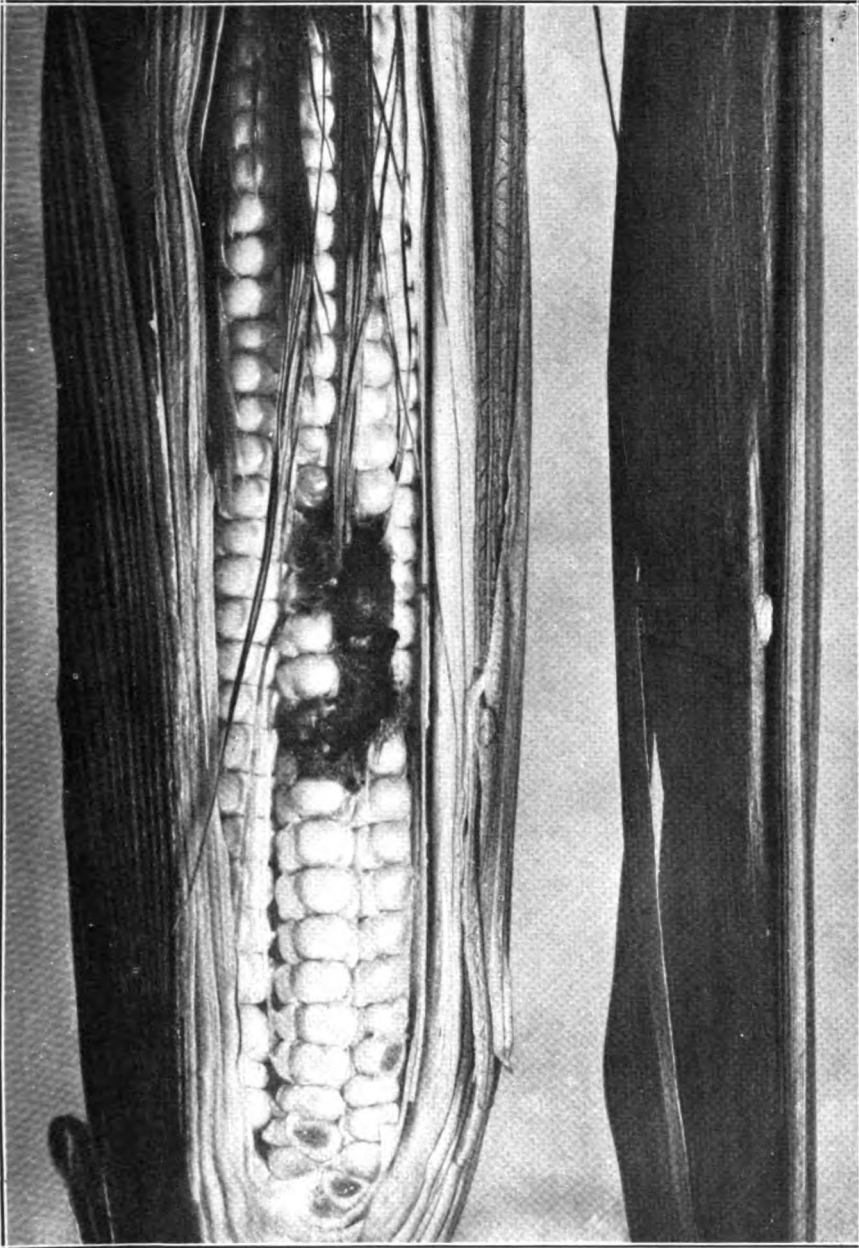


PLATE I

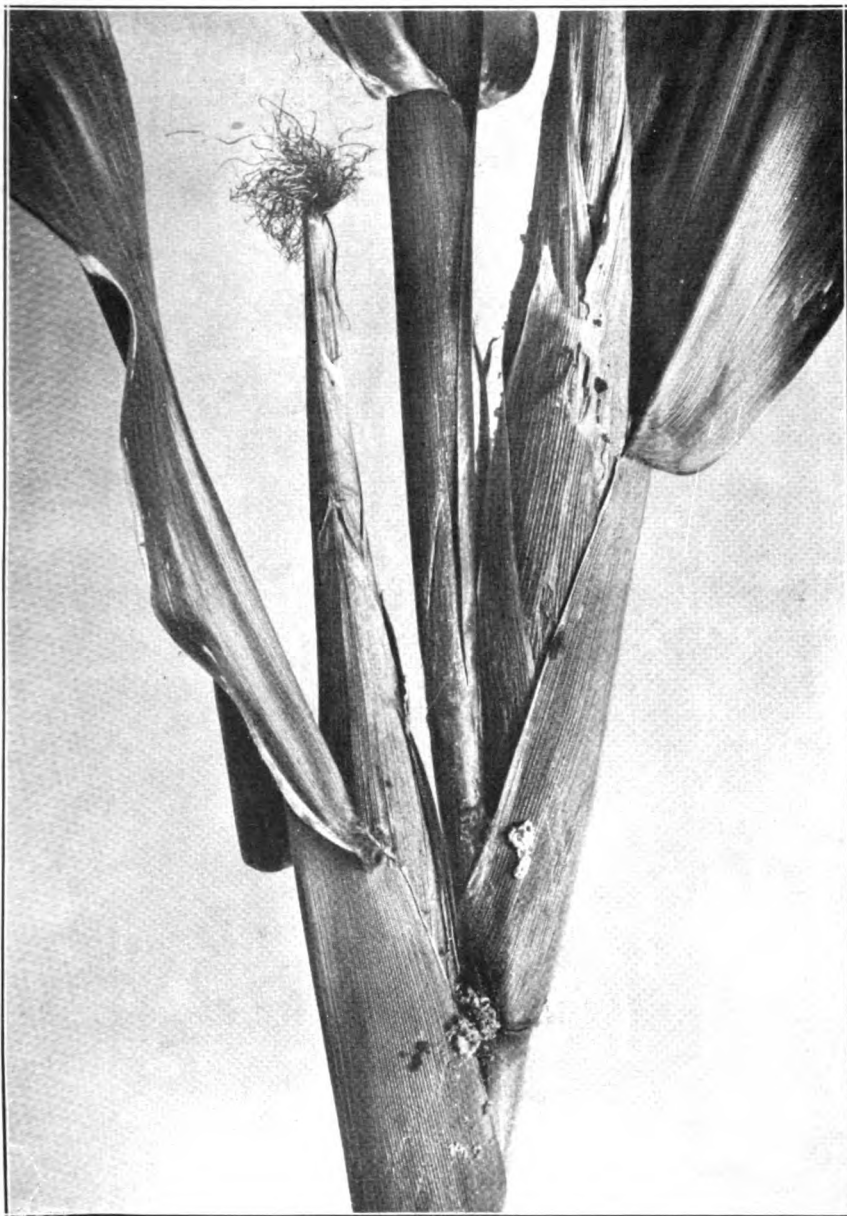


PLATE II

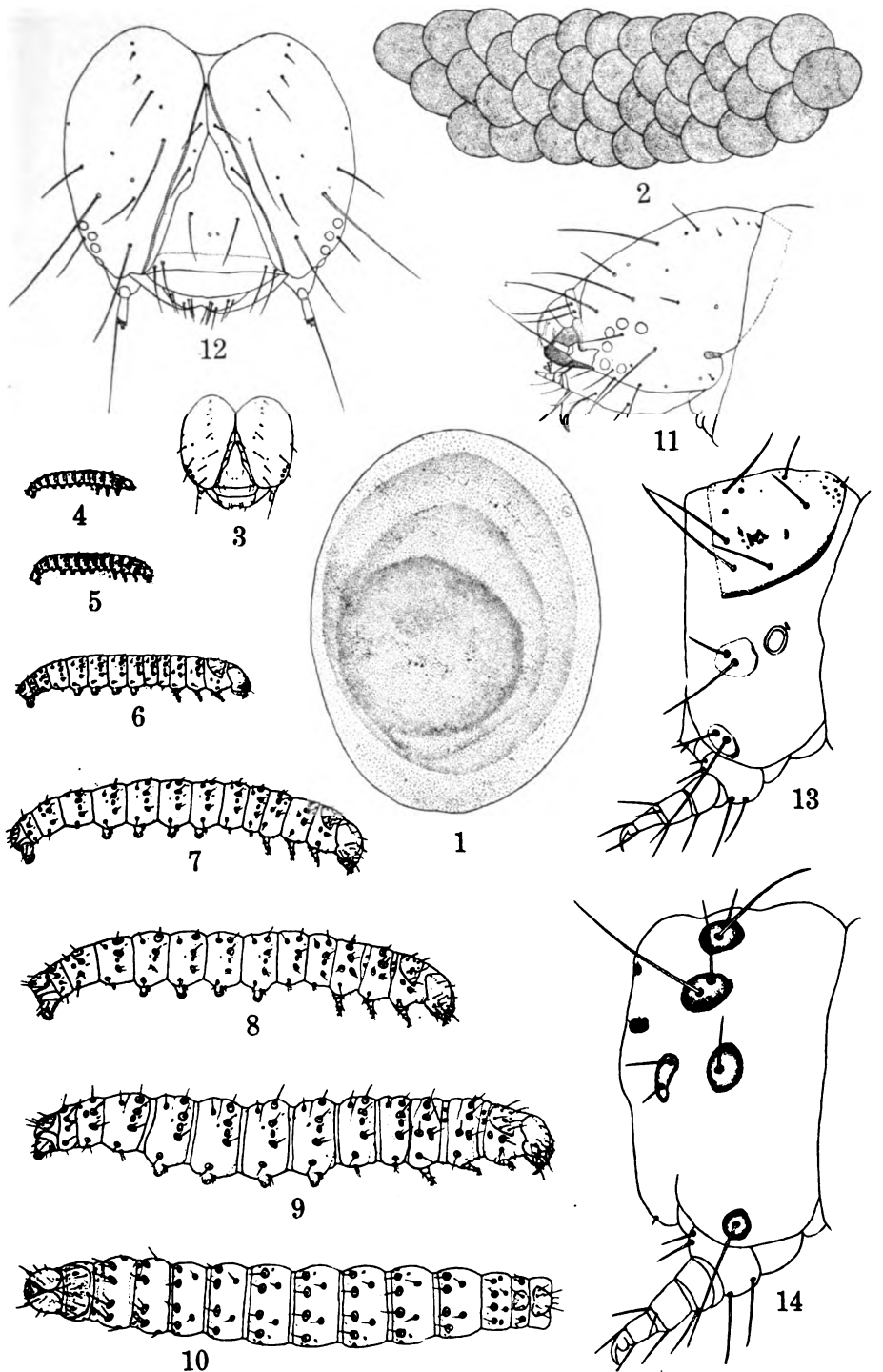


PLATE III

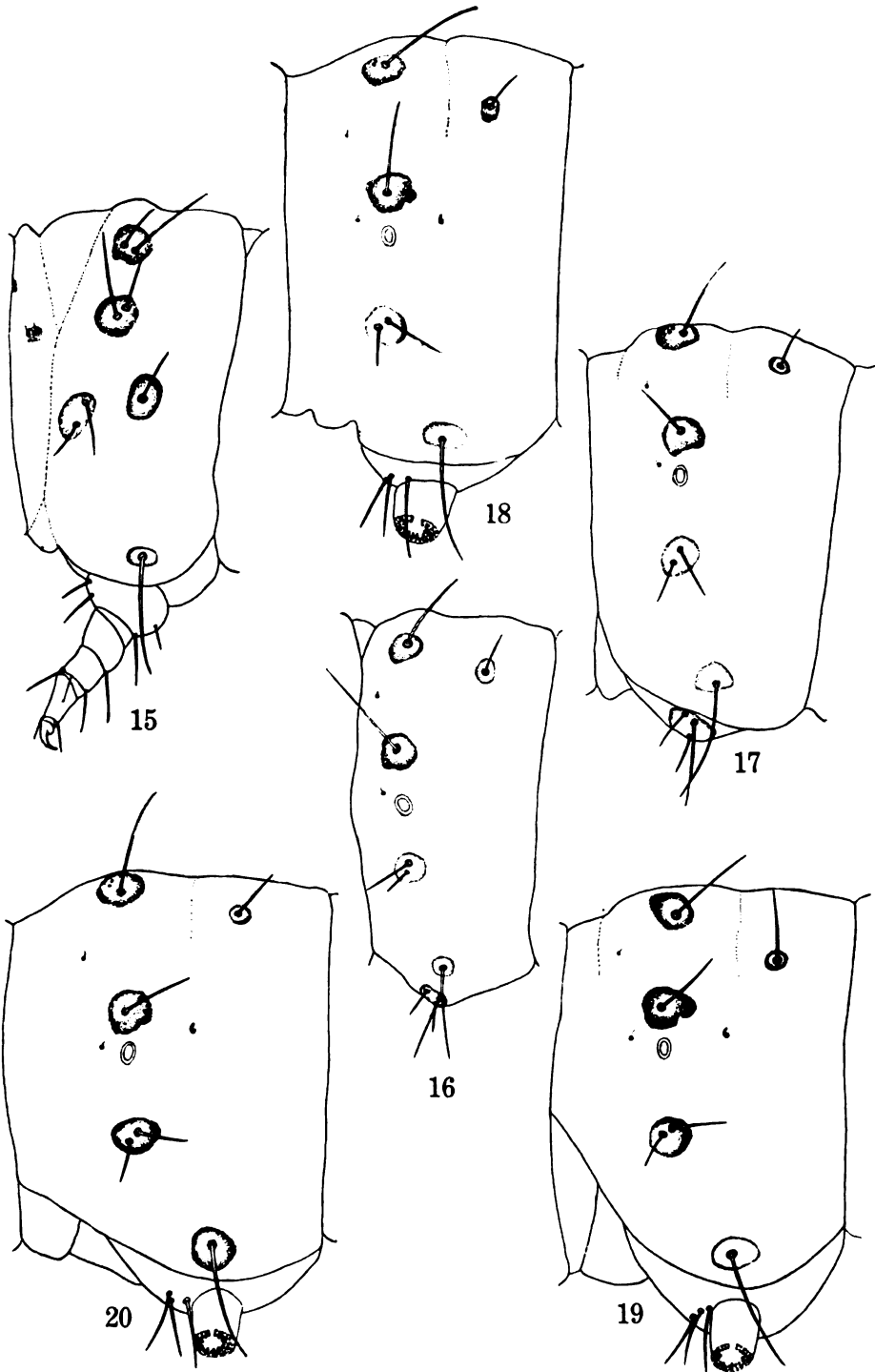


PLATE IV

Buligan: The corn borer]

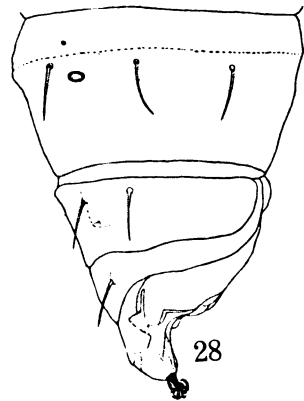
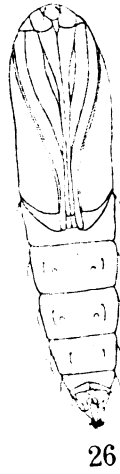
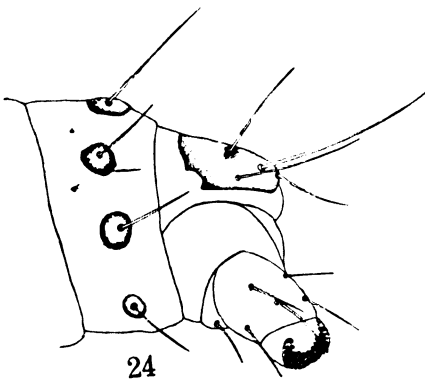
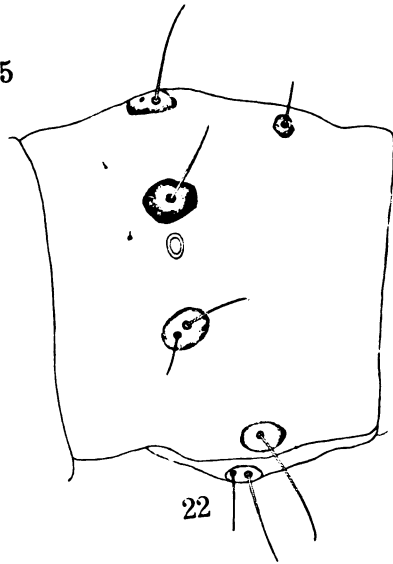
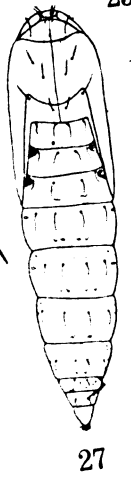
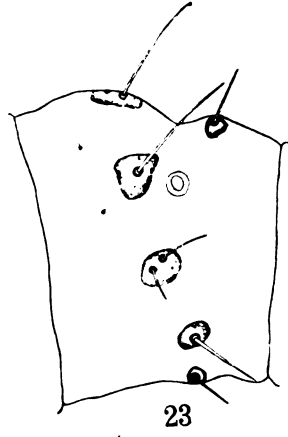
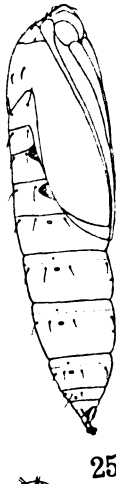
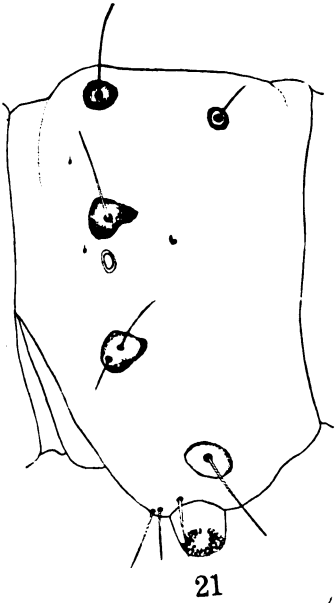


PLATE V

Buligan: The corn borer]

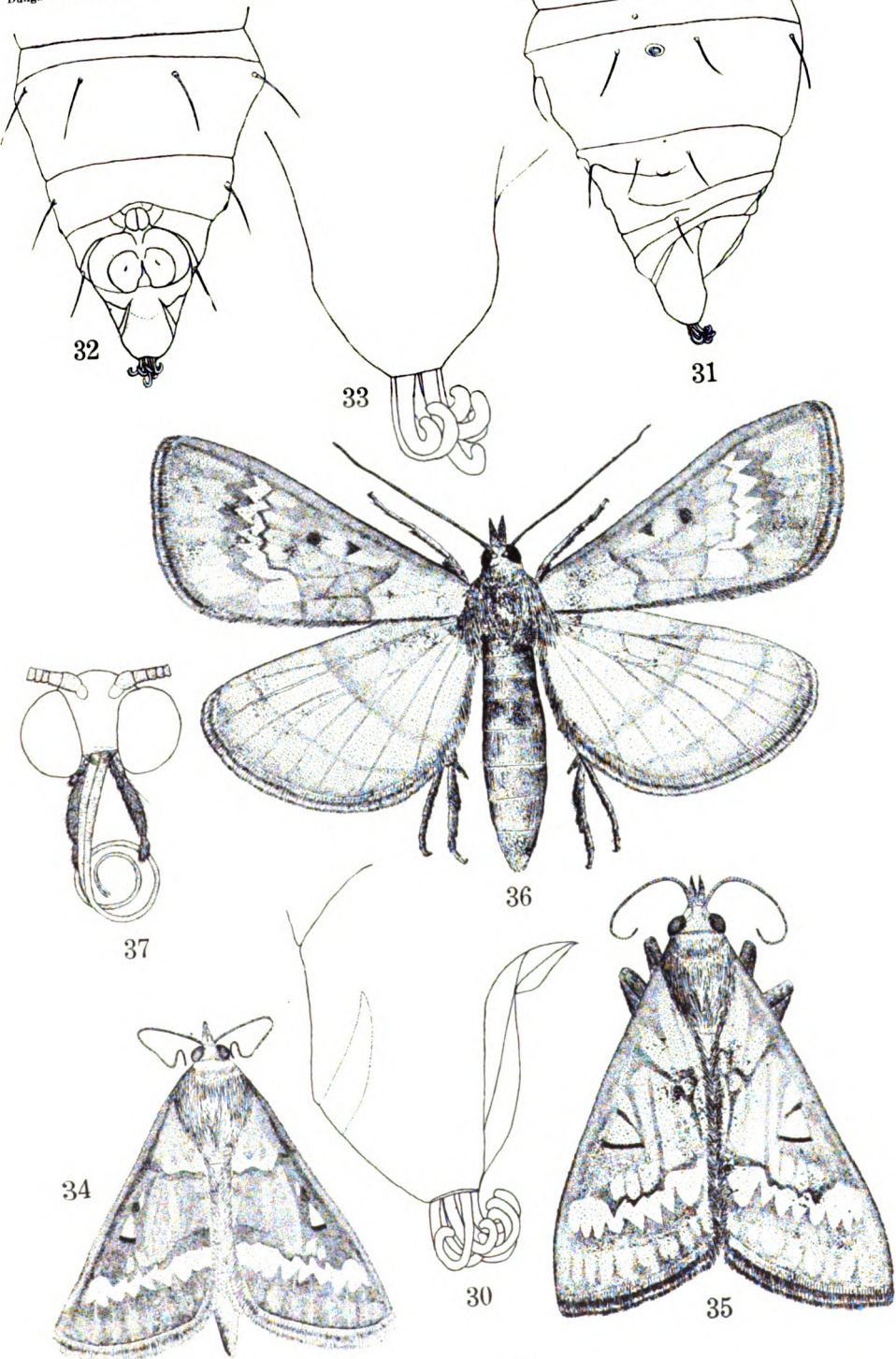
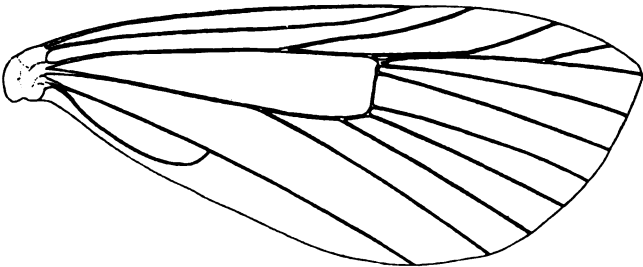
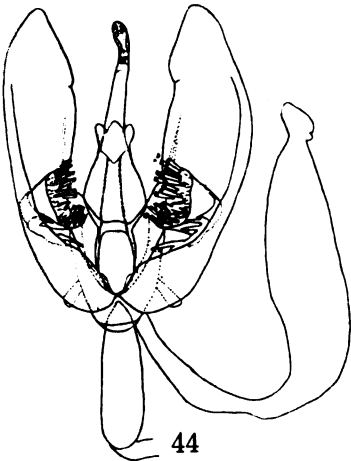


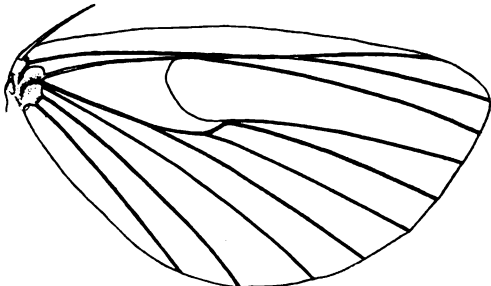
PLATE VI



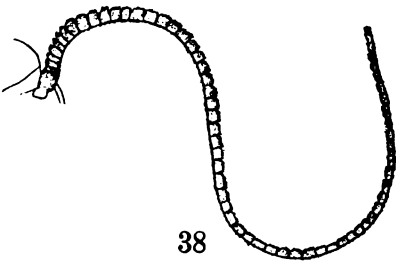
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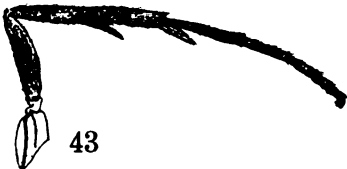
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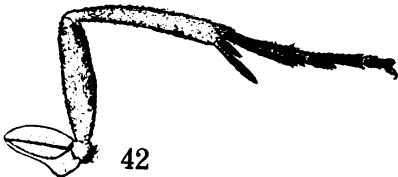
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PLATE VII

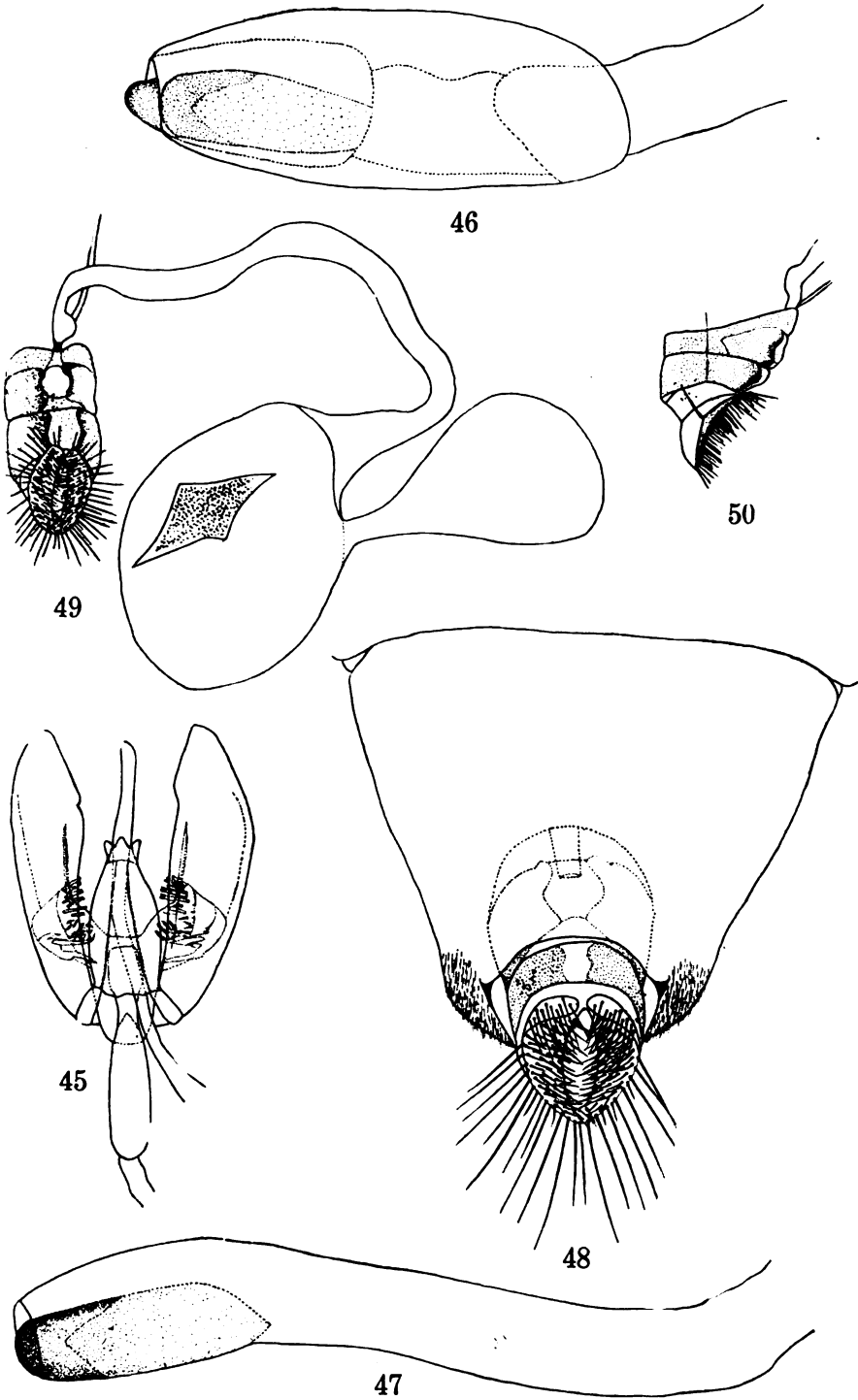


PLATE VIII

THE CORN BORER, *PYRAUSTA NUBILALIS* HÜBNER (PYRALIDAE, PYRAUSTINAE, LEPIDOPTERA)¹

CATALINO T. BULIGAN

WITH EIGHT PLATES

INTRODUCTION

General statement of the problem

The corn borer, *Pyrausta nubilalis* Hübn., is one of the worst enemies of corn in the Philippines. The work of the larvae causes breaking of the stalks in a heavy wind, destruction of the silk, and failure of ears to mature.

Damage to corn in the field is often considerable. Infested plants produce few marketable ears or none at all, and, in some localities, fifty per cent or over of the season's crop is destroyed. The pest then is of great economic importance, especially in view of the fact that corn constitutes the principal staple food in some regions of the Philippines, notably among the working classes of the Ilocano and Visayan provinces.

Systematic position

Through the courtesy of Mr. Carl Heinrich and Mr. D. W. Jones, of the United States Bureau of Entomology, the pest under discussion has been determined as identical with the well-known European corn borer in the United States and Europe, *Pyrausta nubilalis* Hübner (Pyralidae, Pyraustinae, Lepidoptera). According to Mr. Heinrich, *P. vastatrix* Schultze, under which name the corn borer as it occurs in the Philippines is usually known, is apparently a synonym. He reports in part that "if the specimens in the [U. S. National] Museum collection are properly determined, the following will have to be listed as synonyms of *P. nubilalis*: *polygoni* Dyar, *demailis* Walker, *vastatrix* Schultze, and *furnacalis* Guenee."² Caffrey and Worthley (1927) list the following as synonyms of *Pyrausta nubilalis*:

Pyrausta silacealis Hübner
Pyralis glabralis Haworth
Botys silacealis Freyer
Botys lupulinalis Guenee
Botys zealis Guenee
Botys nubilalis Lederer
Botys lupulina Heinemann
Hapalia kasmirica Moore
Hapalia lupulina Butler
Pyrausta nubilalis Meyrick
Pyrausta polygoni Dyar
Pyrausta vastatrix Schultze

¹Thesis presented for graduation, 1928, with the degree of Bachelor of Agriculture from the College of Agriculture No. 275; Experiment Station contribution No. 563. Prepared in the Department of Entomology under the direction of Associate Professor Leopoldo B. Uichanco.

This thesis was awarded the Class of 1925 Medal for best thesis presented in 1928.

²Quoted in letter from D. W. Jones, Arlington, Massachusetts, U. S. A., May 24, 1926, to whom a series of adult specimens from the Philippines had been sent.

Bred adults of *Pyrausta nubilalis* have been found to vary considerably in color shades and patterns.

Review of previous work

In the Philippines. Corn borer has not been adequately studied in this country. Banks (1906), Jones (1913), and Navarro (1911) were among the earliest to record it as very destructive to corn. Woodworth (1921) reported sorghum, millet, and *Panicum* spp. as additional hosts. Schultze (1908) described the adults, and, as noted above, wrongly assigned them to a new species, *Pyrausta vastatrix*.

In other countries. The United States has probably done more than any other country in working out the biology of this pest. It is an imported pest in the Western Hemisphere, having been introduced first into the United States and Ontario, Canada, through shipments of broom corn in 1909 and 1910 (Caffrey and Worthley, 1920). It was first discovered in the United States in 1916 (Huber and Neiswander, 1927). Caffrey and Worthley (1920) report that this species was first identified from Boston, Massachusetts, during the summer of 1917. At that time, the insect was found to be present within an area of at least 100 square miles in the vicinity of Boston. The direction of spread is uncertain, but, according to the report of Caffrey and Worthley (1927), infestation by this pest was discovered at Scotia, New York, in January, 1919; at North Girard, Erie County, Pennsylvania in September, 1919; at the Pennsylvania towns bordering Lake Erie and most of the townships bordering the latter lake in Ohio and Michigan, and also on the islands in the western end of the lake in 1921. The spread has been so rapid, in spite of all safeguards undertaken, that in 1925 the infested area in North America was estimated at 80,609 square miles (Drake, 1926). There has been in operation for several years, as a branch of the United States Bureau of Entomology, an European corn borer laboratory at Arlington, Massachusetts. This station is mainly concerned with importation of corn borer parasites from abroad, and propagating and liberating them in infested areas. Writing in 1925, Caffrey reports that up to that time 1,168,276 introduced parasites had been set free. These consisted of seven species; namely, *Zenillia roseanae* B. et B., *Eulimnerea crassifemur* Thom., *Angitia punctoria* Roman, *Habrobracon brevicornis* Wesm., *Exeristes roborator* Fabr., and *Phaeogenes planifrons* Wesm.

Wade (1925) published a comprehensive bibliography of the European corn borer, which consists of some 900 titles mainly from the pen of European and American entomologists. The earliest paper in the list was published in 1812.

Geographical distribution

Pyrausta nubilalis is practically a cosmopolitan species. It has been reported from all the zoogeographical regions, except the Australian and

the Ethiopian. It is, however, known to occur in Egypt, which, although Palaearctic, is not very far from the Ethiopian region.

The pest is of recent introduction in the Western Hemisphere, so that the original home is presumably somewhere in the Old World. It follows, therefore, that corn, which is a native of America, is not the original host, but has been secondarily acquired on the introduction of this crop into the Eastern Hemisphere. Huber and Neiswander (1927) believe that the probable original food plant of this insect was the wild hop.

The following list gives the countries wherein *Pyrausta nubilalis* has been recorded. They are grouped in their respective zoögeographical regions, as established by Selater and Wallace:

<i>Countries</i>	<i>Nearctic Region Authorities</i>
United States.....	Adkins (1919) Atwood (1919) Babcock (1924) Britton (1919a, 1919b, 1919c, 1921, 1923, 1924, 1925) Barber (1921a, 1924b, 1924c, 1925a, 1925b, 1925c, 1925d) Bourne and Fernald (1919) Bauer, Flint, and Hackleman (1923) Caffrey (1919a, 1919b, 1924, 1925) Caffrey and Vinal (1919) Caffrey and Worthley (1922, 1927) Cotton (1921) Dean (1925) Drake (1926) Felt (1919a, 1919b, 1919c, 1919d, 1919e, 1919f, 1920a, 1920b, 1921a, 1921b, 1921c, 1921d, 1922, 1923) Fernald (1918) Flint and Malloch (1920) Hadley (1925) Haseman (1920) Heinrich (1919, 1921) Holloway (1921) Howard (1919a, 1919b, 1921, 1922) Houser (1919) Huber and Neiswander (1924a, 1924b, 1924c, 1925, 1927) Hyslop (1922) Jones (1924) Keenan (1922) Lyle (1921) Mackie (1923) Marlatt (1919a, 1919b) Mosher (1919a, 1919b) Osborn (1926) Parks (1924, 1926a, 1926b) Pettit (1920a, 1920b, 1925a, 1925b) Reynolds (1919) Roberts (1919)

- Severin (1922)
 Smith (1920, 1923)
 Thatcher (1925)
 Thompson, M. C. and W. R. (1921, 1923)
 Thompson, W. R. (1922)
 Vinal (1917)
 Wade (1925)
 Wallace (1922)
 Walton (1920, 1921)
 Woodbury (1919)
 Worthley (1924, 1926)
- Canada.....Baird (1924)
 Caesar 1922, 1923,
 1924a, 1924b, 1924c, 1925)
 Crawford (1921, 1923a, 1923b, 1924)
 Crawford and Spencer (1921, 1922a, 1922b, 1923)
 Crawford and McLaine (1925, 1926)
 Felt (1919c)
 Ficht and Painter (1924a, 1924b)
 Gibson (1920)
 Keenan (1920, 1922, 1923)
 Lochhead (1920)
 McLaine (1919, 1920, 1921a, 1921b, 1922a, 1922b, 1923,
 1924)
- Neotropical Region*
- Countries Authorities*
- Argentina.....Sobrero (1924)
- Palearctic Region*
- Countries Authorities*
- Portugal.....Mendes (1913)³
 British Isles (U. K.).....Barrett (1875)³
 France.....Genieys (1922)
 Lesne (1920)³
 Marchal and Foex (1918, 1922)
 Marchal (1914)³
 Noel (1917a, 1917b)
 Poutiers (1922)
 Rives (1919)
 Vuillet (1913, 1919)
 Holland.....Picquendaele (1910)
 Belgium.....Picquendaele (1919)
 Germany.....Caffrey (1925)
 Picquendaele (1919)
 Hungary.....Bako (1917a, 1917b,
 Kadoosa (1923)
 Caffrey (1925)³
 Emich (1894)³
 Fabricius (1914)³
 Europe (Central and Southern). Drake (1926)
 Felt (1920a)
 Vinal (1917)

³ From Wade (1925)

Russia.....	Anutchin (1918) ³ Dobrodeiv (1921) Dreier (1914) ³ Keshkovsky (1918) Kostinsky (1915) ³ Krassilstchik (1915) ³ Kurdiumov (1914) ³ Miller (1915) ³ Paczoski (1916) Uvarov (1917) Vassiliev (1917) Vereshtchagin (1922) Zvierzomb-Zubovsky (1918, 1920)
Egypt.....	Andres (1913) ³
Asia (Central and Northern)....	Drake (1926) Felt (1920a) Vinal (1917)
China.....	Drake (1926)
Japan.....	Drake (1926) Felt (1920a) Takahashi (1919) Vinal (1917)

*Oriental Region**Countries**Authorities*

India.....	Hampson (1896a)
Philippine Islands.....	Jones (1913) Navarro (1911) Schultze (1908) Woodworth (1921) In addition to the present report

*Oceanic Islands (unclassified)**Countries**Authorities*

Guam.....	Griggs (1919, 1921a, 1921b, 1922)
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Object of the present work

The object of the present work was to study the biology of *Pyrausta nubilalis* with the end in view of finding methods of control applicable under Philippine conditions.

Time and place of the present work

Experiments were begun in October, 1924 and carried through December, 1926. The work was conducted in the fields and in the entomological laboratory of the College of Agriculture, University of the Philippines, Los Baños, Laguna.

MATERIALS AND METHODS

Insectary methods

Life history observations. Larvae and pupae collected from the field were kept in mass cultures in battery jars; the pupae in separate jars from

³From Wade (1925)

the larvae. Fresh portions of corn stalk were supplied regularly to the larvae as needed, and the old feed removed. It was found in the course of the work that it was not necessary to renew the stalks more than twice a week. Pairs of one male and one female which emerged from the larvae were isolated in small, wide-mouthed bottles which were stoppered with a thick wad of cotton. A fresh cotton pellet moistened with water was supplied daily to the moths. The cultures were inspected in the morning for eggs, and moths that were found to have oviposited were transferred to another bottle. All bottles were carefully labelled so as not to confuse the different cultures.

Newly hatched larvae were isolated individually in cotton stoppered vials and supplied with a piece of fresh corn stalk, which was renewed daily. Each vial was given a number for convenience in recording instars and other biological data.

Anatomical material, consisting of eggs, different larval instars, and pupae were fixed in water at 80°C. for from five to ten minutes, pricked and then preserved in 70 per cent alcohol. Adults were mounted on pins.

Collection of parasites. Eggs brought in from the field were kept in vials, so as to secure egg parasites. Parasites of larvae and of pupae were collected from the mass cultures used in breeding out adult moths. Predators were gathered from the field.

Field observations

Regular field inspection at least once a week was made in an effort to determine seasonal occurrence and abundance, nature of damage in the field, alternative host plants, places of oviposition in nature, habits of the insect in each of the various stages, and other biological field data.

This phase of the work covered practically the entire campus of the College of Agriculture and vicinity. Observations of corn fields were started when the plants were seedlings and continued up to maturity of the crop. Infested corn plants were closely examined to determine the nature of the damage, places of oviposition, habits of the insect in each of the various stages, and natural enemies of the pest. Several corn plants bearing egg masses on the leaves were tagged and observed closely for the behavior of the larvae after hatching.

Field inspection was eventually extended to the examination of other species of plants (both cultivated and wild). The object was to determine the alternative hosts of the corn borer. Any plant found attacked by boring insects was examined. Those borers which were hardly distinguishable from the larvae of *Pyrausta nubilalis* were brought to the insectary and bred to the adult stage.

RESULTS AND DISCUSSIONS

Description

Adult male (pl. 6, fig. 34). Length (based on sixty-eight specimens) 8 to 14 millimeters, average 11.6; width 1.3 to 3, average 2; expanse of

wings 20 to 28, average 25.5; length of fore wing 9 to 12, average 11.3; width 4.5 to 6, average 5.5; length of hind wings 7 to 9.5, average 8.5. General color, yellowish ochraceous, varying from light to dark (adults reared during dry season darker than those reared during rainy season). Body yellowish ochraceous dorsally and pale stramineous ventrally. Eyes black. Legs pale yellow. Fore wing ochraceous, with characteristic markings as follows: a brownish ochraceous band, occupying about one-third total area of wing, extending from anal margin to costal margin, midway between extremities of wing at a distance of about one-third total length of latter from either humeral angle or apical margin of wing, with dark ochraceous, narrow, very sinuous border anteriorly, a subtriangular ochraceous area on posterior half of discal cell, with a dark ochraceous spot at short distance from anterior angle, and bordered by dark ochraceous line posteriorly; posterior margin serrately sinuous; a second dark ochraceous band extending from anal margin to costal margin of wing and occupying about one-fourth total length of latter posteriorly, with series of irregular length-wise ochraceous lines; anterior margin diffuse; posterior margin flush with apical margin of wing. Hind wing yellowish stramineous, an ochraceous band which occupies about one-fifth total length of wing posteriorly. Posterior margins of abdominal segments bearing conspicuously paler yellowish white scales than rest of body.

Head (pl. 6, fig. 37) suboval from anterior aspect, about two-thirds as long and as wide as mesothorax. Eyes subspherical, occupying about two-thirds total area of head. Frons subrectangular, about one-third as wide as total breadth of head. Vertex subtrapezoidal from dorsal aspect, about as long as broad, bearing two ocelli, which are subspherical and situated posterior to base of antennae, about as broad as apical segment of antennae. Antennae (pl. 7, fig. 38) filiform, about one and one-fourth times as long as total length of body, located dorsal to compound eyes, moderately covered with scales, segments varying from 60 to 62 in number; basal segments on the average about one-half as long as broad, about two-thirds as long as and three times as broad as distal segments; distal segments about twice as long as broad; apical end of terminal segment bearing three cylindrical spines. Labial palpi porrect, densely covered with scales, about one and one-half times as long as diameter of eyes, situated ventrally with respect to maxillary palpi, three-segmented; I subellipsoidal, attenuate basally, about twice as long as broad, about two-fifths as long as II; III subfusiform, about as wide as I, slightly tapering distally; III subellipsoidal, about three times as long as broad and about one-half as broad as II. Maxillary palpi porrect, densely covered with scales, about one and one-fourth times as long as and two-fifths as broad as segment I of labial palpi, about one fifth as broad as long, four-segmented; I about one-half as long as broad; II about as long as wide, about one and one-half times as long as and three-fourths as wide as I; III subcylindrical, rounded at both ends, about as

broad and one and one-third times as long as II; IV suboblong, about as long as III, about two-thirds as broad as long. Maxillae (proboscis) moderately covered with scales basally, about four-fifths as long and two-thirds as wide as antennae.

Thorax subcylindrical, about one-fifth total length of body. Prothorax about one-third as long and about two-thirds as wide as head; patagia subfusiform, unsegmented, densely covered with scales, attached to prothorax laterodorsally, about one-third as broad as prothorax and about four times as long as wide. Mesothorax about as long as wide, about six times as long and twice as broad as prothorax; tegulae finger-shaped, densely covered with long scales, attached to anterior portion of mesothorax laterodorsally, about one-fourth as broad as mesothorax, and about one-third as broad as long. Metathorax tapering posteriorly, about three-fourths as long and three-fourths as wide as mesothorax, about two-thirds as long as broad. Fore wing (pl. 7, fig. 39) about two and one-half times as long as broad, about one and one-third times as long and five-sixths as broad as hind wing. Discal cell elongately subtriangular, about five times as long as broad distally, about one-half as long and one-fourth as broad as wing; proximal angle describing about 15 degrees. C about two-thirds as long as costal margin of wing; cell C narrowly subelliptical, about one and one-tenth times as long and one-fourth as broad as discal cell, about twenty-two times as long as wide; Sc about as long as C, curving subdistally toward costal margin, meeting latter at about one-third length of costal margin from apical angle of wing; cell Sc about one-fourth as broad and one and one-fifth as long as discal cell, subuniform in width throughout, curved subdistally toward costal margin; R about two-thirds as long as Sc, branching midway between base and apex of wing into R_1 and R_s ; R_1 about four-fifths as long as R, describing an angle with R_s of about 13 degrees, slightly curving toward costal margin and meeting latter at a distance of about two-sevenths length of wing from apex of latter; cell R_1 subtriangular, about four-fifths as long and two-thirds as broad as discal cell, about one-third as broad as long; R_s about one-fourth as long as R, branching at ectodistal angle of discal cell into R_2 and R_4 ; R_2 about as long as R_1 , about one-half length subbasally coalescent with R_4 , curving toward costal margin and meeting this margin approximately midway between distal end of R_1 and apex of wing; cell R_2 subtrapezoidal, about one-fourth as broad as long, about four-sevenths as long and two-thirds as broad as cell R_1 ; R_3 about one-third as long as R_2 , branching out from R_4 at about three-eighths length of latter from apex of wing, describing an angle of about 19 degrees with R_4 , meeting costal margin about midway between R_2 and apex of wing; cell R_1 subtriangular, tapering proximally, about one-fourth as broad as long, about five-sevenths as long and three-fourths as broad as cell R_2 ; R_4 about four times as long as R_s , slightly curving basally toward R_s , coalescent basally with R_s at ectodistal angle of discal cell and describing an angle of about

14 degrees, terminating at apex of wing; cell R_4 elongately subtriangular tapering proximally, about one-eighth as broad as long, about four-fifths as long and two-thirds as broad as discal cell; R_5 about as long as R_4 , slightly curved, subparallel to costal margin, extending from base of discal cell to apical margin of wing, meeting this margin at a distance of about three-fifths of vein R_5 from apex to anal angle of wing; cell R_6 elongately subrhomboidal, tapering proximally, about one-seventh as broad as long, about as long and as broad as cell R_4 ; veins R_1 , M_1 , M_2 , M_3 , Cu_1 , and Cu_2 terminating at apical margin of wing, subequidistant; M_1 slightly shorter than R_5 , connected to R_5 by distinct radiomedial cross-vein (r-m), which is about one-tenth length of R_5 ; cell M_1 elongately subrectangular, about seven times as long as broad, about as broad as cell R_5 and slightly shorter than the latter; M_2 subparallel to M_1 , slightly shorter than the latter, about seven-eighths as long as R_4 , originating from discal cell and connected basally with M_1 by discal vein (d), which is about four and one-half times as long as cross-vein r-m; cell M_3 rhomboidal, tapering basally, proximal margin about one-fourth as long as distal margin, about one-seventh as broad as long, about three-fourths as broad and fourteen-fifteenths as long as cell R_5 ; M_2 subrectilinear, slightly shorter than M_3 , originating from discal cell at entodistal angle of this cell, connected basally with M_3 by medial cross-vein (m), which is about one-fourth the length of discal vein (d); cell M_4 subtrapezoidal, tapering basally, about one-seventh as broad as long, about as long and one and one-third times as broad as cell M_3 ; C_1 (cubitus 1) curving abruptly along discal cell, deflected entobasally at an angle of about 155 degrees and connected to M_4 by mediocubital cross-vein (m-cu), which is about two and two-thirds times as long as medial cross-vein (m), from point of curvature to base of Cu_1 , about one and one-third times as long as M_4 , branching with Cu_2 from a principal vein Cu at ental margin of discal cell at a distance of about one-half length of vein M_4 from base of latter to proximal angle of discal cell; cell C_1 subtrapezoidal of almost uniform breadth, about one-seventh as broad as long, about as broad and one and one-third times as long as cell M_3 ; Cu_2 subrectilinear, slightly shorter than Cu_1 , subparallel to Cu_1 , describing an angle of about 20 degrees with basal portion of vein Cu_1 along ental margin of discal cell; cell $Cu + Cu_2$ subtrapezoidal, about one-eighth as broad as long; about one and five-eighths times as long and two-thirds as broad as cell Cu_1 ; Cu about four-fifths as long as vein Cu_1 , bordering proximally along ental margin of discal cell; 2A slightly arcuate toward anal margin, describing proximally with Cu an angle of about 16 degrees, about one and one-half times as long as Cu_2 , terminating at anal angle; 3A about one-half as long as 2A, very close to 2A basally, curving toward anal margin and nearly reaching this margin, then bending toward 2A and meeting the latter at a distance of about five-elevenths length of 2A from base of latter; cells 1st 2A and 2nd + 3A together describing a narrowly subelliptical figure, about ten times as

long as broad, about one and one-fifth times as long and three-fourths as broad as discal cell. Cell 1st 2A about five times as long as broad, about five-twelfths as long and three-fourths as broad as 1st 2A+2nd 2A+3A, distinctly separated from 2nd 2A+3A by vein 3A. Hind wing (pl. 7, fig. 40) about one and three-fourths times as long as broad, bearing a single frenulum; consisting of one stout long slightly curved spine, about one-fifteenth as broad as long, about one-fifth as long as total length of wing. Discal cell subtriangular; distal margin emarginate and bordered by discal vein (d); ectal margin about two-thirds as long as ental margin; proximal angle about 30 degrees; about twice as long as broad; about one-third as long and one-fourth as broad as wing. Cell C elongately narrowly subelliptical, about fifteen and one-half times as long as broad, about six-sevenths as long and one-tenth as broad as wing; Sc originating near base of frenulum, uniting with R beyond discal cell to form vein $Sc+R_1+R_s$; cell Sc elongately subtriangular, about one-twelfth as long as broad basally, about three-sevenths as long and four-sevenths as broad as cell C; $Sc+R_1+R_s$ about two-sevenths as long as Sc, branching into veins $Sc+R_1$ and R_s ; $Sc+R_1$ about two and one-fifth times as long as $Sc+R_1+R_s$, describing an angle with R_s of about 13 degrees, extending toward costal margin and meeting the latter at about the length of $Sc+R_1+R_s$ from apical angle of wing; cell R_1 elongately subtriangular, about one-seventh as broad as long, about as long and twice as broad as cell Sc; R_s about one and one-fourth times as long as $Sc+R_1$, subparallel to costal margin; cell R_s elongately subtriangular about nine times as long as broad, about as broad and one and two-thirds times as long as cell R_1 ; R about as long as Sc, bordering ectal margin of discal cell, meeting vein $Sc+R_1+R_s$ beyond this ectal margin; M_1 about one and one-half times as long as R_s , originating from discal cell, describing an angle of about 18 degrees with distal end of R, extending distally and meeting apical margin at about one-fourth length of $Sc+R_1$ from apex of wing; cell M_1 subtrapezoidal, about one-sixth as broad as long, proximal margin rounded and bordered with discal vein which is about one and four-fifths times as long as distal margin, about as broad and twice as long as discal cell; M_1 , M_2 , M_3 , Cu_1 , Cu_2 , and 1A subequal in degree of curvature, subequidistant distally; M_2 subparallel to R_s , about five-sixths as long as M_1 , originating from discal cell at entodistal angle of it; cell M_2 elongately subtriangular, tapering basally, about four times as long as broad, about five-sixths as long and about one and one-fourth times as broad as cell R_s ; M_3 slightly shorter than M_2 , originating close to base of latter and basally describing an angle with M_2 of about 13 degrees, connected to Cu_1 by mediocubital cross-vein (M-Cu), which is about one-tenth as long as Cu_1 ; cell M_3 elongately subtrapezoidal, slightly tapering basally, about one-seventh as long as broad, about as broad and one-seventh as long as cell M_2 ; Cu_1 about as long as M_3 , branching along ental margin of discal cell with Cu_2 at about one-third the length

of M_1 from base of latter; cell Cu_1 elongately trapezium-shaped, tapering basally, about as long and as broad as cell M_1 ; Cu_2 about five-sixths as long as Cu_1 , describing an angle with Cu_1 basally of about 16 degrees; Cu about one-half as long as Cu_2 , bordering two-thirds ental margin of discal cell; cell $Cu + Cu_2$ elongately subtrapezoidal, tapering basally, about ten times as long as broad, about as broad and one and one-half times as long as cell Cu_1 ; 1A less prominent than other veins, originating close to base of Cu and describing an angle with Cu of about 9 degrees, about one and one-third as long as Cu_1 ; cell 1A subtrapezoidal, tapering basally about six times as long as broad, about as long and as broad as cell M_1 ; 2A about ten-twelfths long as 1A, terminating on anal margin at about two-thirds length of Cu from distal end of 1A to anal margin of wing; cell 2A elongately subtrapezoidal, tapering basally, about eight times as long as broad, about four-fifths as long and two-thirds as broad as cell 1A; 3A about four-fifths as long as 2A, slightly curving toward anal margin, meeting this margin at about a distance of one-half length of Cu from distal end of 2A; cell 3A narrowly subhemiellipsoidal, about nine times as long as broad, about one-half as long and one-half as broad as cell C. Fore leg (pl. 7, fig. 41) about as long as total length of body; coxa elongately subconoidal, about one-fifth as long as total length of leg, about one-third as broad as long; trochanter subtriangular, length subequal to width of coxa; femur subfusiform, about one and two-fifths times as long and two-thirds as wide as coxa; tibia subcylindrical, slightly tapering distally but more markedly so basally from middle, about three-sevenths as long and two-thirds as broad as femur, an ental spur midway between extremities; spur about one-half as long as tibia, densely covered with scales and tapering distally; tarsus about three times as long as tibia, five-segmented; segments subcylindrical, I (metatarsus) about one and one-fourth times as long and about two-thirds as broad as tibia; II about two-thirds as broad as and two-fifths as long as I, subequal length and width of either III, IV, or V, which are of nearly the same dimensions; claws stout, sharply pointed, arcuate ventrally, about one-fourth as long and one-third as broad as V, about twice as long as broad. Middle leg (pl. 7, fig. 42) about one and one-sixth times as long as fore leg; coxa subconoidal, about one-eighth as long as total length of leg, about two-thirds as wide as long; trochanter subcylindrical, about one-third as long as coxa; femur subfusiform, about one-fourth as long as total length of leg, about two-thirds as broad as coxa; tibia subcylindrical, tapering basally, about one and one-sixth times as long and two-thirds as broad as femur, unequal entodistal spurs; larger spur about twice this size of the smaller, about two-fifths as long and two-sevenths as broad as tibia; tarsus about as long as tibia, five-segmented; each segment subcylindrical, bearing two short entodistal spurs with exception of V; I (metatarsus) tapering basally, about one-third as wide and two-fifths as long as tibia; II about one-half as long and as broad as I; III about two thirds length and two-thirds

width of II; IV about one-half as long and one-half as wide as III; V about as long and as broad as IV; claws subequal to those in fore legs. Hind leg (pl. 7, fig. 43) smaller than middle leg, about one and one-eighth times as long as total length of fore leg, subequal in length to middle leg; coxa subconoidal about one-eighth as long as total length of leg, width about two-thirds length; trochanter subconoidal, about one-third length and one-third width of coxa; femur abruptly subfusiform, tapering basally and distally from middle, about twice as long and two-thirds as broad as coxa, two-elevenths as long as total length of leg; tibia subcylindrical, tapering basally about three-fourths as broad and one and seven-tenths as long as femur; two pairs of ental spurs as follows: first pair midway between extremities; second pair located entodistally, one of each pair about two-thirds the other; tarsus about one and one-fourth times as long as tibia, five-segmented, segments of subequal width and each, except V, bearing a short entodistal spur; I (metatarsus) tapering basally, about one-half as long as tibia; II about three-fifths as long as I; III about two-thirds as long as II; IV about one-half as long as III, subequal in length to V; claws subequal to those in fore legs.

Abdomen extending caudally beyond anal angles of fore wings, elongately subfusiform, tapering from segment III anteriorly and posteriorly; eight distinct segments; I about two-thirds as long as wide, about one-half as long as metathorax; II about one-third as long as broad, about as long and one and one-third times as broad as I; III about three-fifths as long as wide, about twice as long and as broad as II, subequal length of either IV, V, VI, VII, or VIII, which have about the same measurements; IV about three-fourths as long as broad, about eleven-twelfths as broad as III; V about four-fifths as long as wide, about eleven-twelfths as broad as IV; VI about four-fifths as long as broad, about as long and as wide as V; VII about one and one-fourth times as long as broad, about three-fourths as wide as VI, about one-half as broad as III; VIII about two-thirds as broad and as long as VII.

Male genitalia (pl. 7, fig. 44 and pl. 8, fig. 45) densely covered with long hairs, strongly chitinized, one and one-third times as long as and slightly narrower than abdominal segment VIII, about one-fourth length of it, extending caudally beyond distal margin of VIII; aedoeagus (pl. 8, fig. 46) subfusiform, moderately chitinized, about three and one-half times as long as broad, about one-fifth as broad and three-fourths as long as abdominal segment VII; penis (pl. 8, fig. 46 and 47) subcylindrical, membranous, lying within and occupying about four-fifths width and entire length of aedoeagus, about twice as long as aedoeagus when extended, apically with subcylindrical highly chitinized process, the vesica (Pierce, 1914, cited by Eyer, 1924); vesica about two-fifths as long and about one-half as wide as aedoeagus, attached to ventral wall of penis and situated just behind apex of aedoeagus. Vinculum U-shaped from ventral aspect, heavily

chitinized, about one and one-third times as long as broad, about one and one-third times as broad and one-third as long as aedoeagus; anellus membranous, opening suboval, slightly broader than aedoeagus, bearing juxta and two projecting lobes which are each connected to harpe by a chitinized arm; juxta V-shaped, slightly chitinized, located on ventral surface of anellus, about two-thirds length and two-thirds width of vinculum; transtilla a strongly chitinized band about one-fourth as long as broad and as broad as anellus, one pair of posterolateral arms connecting harpes situated laterally with respect to clasper, and a second anterolateral pair extending to outer margin of anellus, subequal in size to first pair, tapering distally, about one-sixth as broad as long, the breadth about one-half the length of transtilla; harpes elongately scoopshaped, attached to posterior margin of vinculum, about three and three-fifths times as long as broad, about twice as broad and two and one-eighth times as long as aedoeagus, sacculus occupying about one-half of harpe basally; clasper highly chitinized with spinose oval face at distal end, situated nearly perpendicularly with respect to harpe, subconoidal, tapering basally, attached to sacculus entodistally, about two-thirds as long as broad, about two-thirds as broad and one-seventh as long as total length of harpe; appendiculate thorn strongly chitinized, about as broad and one and one-third times as long as transtilla, bearing one large and two smaller subequal stout spines; large stout spine about as broad and two-thirds as long as any of the arms of transtilla, about one and one-third times as long and likewise as broad as any of the two smaller spines, located anteriorly near base of clasper; cucullus elongate, occupying about one-half distal portion of harpe, about one and seven-tenths times as long as broad, sparsely beset with short bristles on inner surface and densely with long bristles at dorsolateral margin; tegumen membranous, elongately subconoidal, supported by two chitinized arms, which extend proximodistally at base of uncus, about twice as long as broad, about one-half as long as broad as harpe, uncus divided into three subequal lobes distally, crown-shaped from dorsal aspect, beset dorsally with stout bristles on two lateral lobes, about three-fourths as long as broad, about one and one-fifth times as broad as aedoeagus; anal opening situated at entodistal part of subcylindrical process; subcylindrical process inserted between uncus and tegumen, tapering distally, about as long and two-fifths as broad as aedoeagus.

Adult female (pl. 6, fig. 35 and 36). Length (based on sixty-eight specimens) 7 to 14 millimeters, average 11.6; width 2 to 4, average 2.5; expanse of wings 24 to 33, average 29.4; length of fore wings 11 to 16.5, average 19.9; width 5 to 7, average 6; length of hind wing 8.5 to 11, average 9.6. External morphological characters similar to male, with the following exceptions:

General color usually lighter. Body relatively larger and more robust.

Head about two-thirds as long as broad, about one-twelfth as long as total length of body.

Thorax subellipsoidal, about one-third as long as total length of body, about four times as long as head; prothorax about two-thirds as long as broad, about two-thirds as long and as broad as head; mesothorax about as broad as long, about four times as long and one and one-half times as wide as prothorax; metathorax tapering distally, about two-thirds as long and two-thirds as wide as mesothorax. Hind wing with frenulum consisting of two long spines and one short one; long spines subequal in size, stout, about one-fortieth as long as broad, about three times length and seven times width of smaller one, about one-fifth as long as total length of wing.

Abdomen subfusiform, very much less extended caudally beyond anal angles of hind wings than in male and comparatively more blunt distally; I about as long and two-thirds as wide as metathorax; about as long as either II, III, IV, V, or VI, which are subequal in length; II about one and one-third as broad as I, about one-half as long as broad; III about one-third as long as broad, about one and one-third times as wide as II; IV about one-third as long as broad, about one and one-sixth times as wide as III; V subequal length and width of IV, VI tapering distally, about twice as long as broad, about four-fifths as broad as V; VII tapering distally, about three-fourths as broad as long, about two-thirds as wide as VI; VIII about two-thirds as long as wide, about one-fourth as long as and one-third as broad as VII; IX about one-half as long as broad, about three-fourths as broad and three-fourths as long as VIII; X about two-thirds as long and two-thirds broad as IX.

Ovipositor (pl. 8, fig. 48, 49, and 50) surrounded by dense, long scales along posterior margin of abdominal segment VII; strongly chitinized with exception of small area mesoventral to abdominal segments VIII, IX, and X; sparsely chitinized area about one-fifth as broad as corresponding segments. Genital opening situated ventromesal to VIII, subcircular, diameter about three-tenths as broad as VIII, bordered with highly chitinized plates laterally. Highly chitinized plate subtriangular, angulate laterally, about two-thirds as long and one-half as broad as abdominal segment VIII (segment bearing chitinized plates), terminating in another chitinous plate, which is suboval from caudal aspect, emarginate ventrally, beset with long and short setae at margin and with short stout setae at surface, except at anal opening. Anal opening subfusiform, occupying about one-third total surface area of chitinous plate.

Pupa (pl. 5, fig. 25, 26, and 27). Length (based on one hundred specimens) 12 to 19 millimeters, average 14.5; width 2.8 to 4, average 3.34. Body subfusiform; rugose; sparsely beset with minute bristles and spines; anterior end rounded; tapering posteriorly from abdominal segment VI, forming a cone distally; general color in older pupae fuscous; variations due to differences in ages, as follows: immediately after pupating, head, thorax, and ventral part of abdomen whitish yellow, dorsal part yellowish pink; an hour later abdominal tergites pink and light pink posteriorly;

after the second hour, pinkish yellow ventrally and brown dorsally; six hours later, general color brown, which gradually changes to fusco-rufous until it finally becomes fuscous; cephalic and caudal extremities and thoracic nota darker than rest of body.

Head projecting slightly cephalad from base of antennae. Frons subrectangular, beset with two fine bristles anteriorly and two minute bristles basally near insertion of antennae. Vertex subrectangular with a median suture, about one-fourth width and one-fifth length of prothorax. Antennae clearly seen from lateral and ventral aspects, nearly subcoextensive apically with maxillae and fore wing pads, bounded by fore wing pads and mesothoracic legs, segments distinct especially when approaching emergence, insertion in head clearly seen from lateral aspect just dorsally from eyes, about one-third as broad as mesothoracic legs and about one-half as long as total length of body. Eyes situated caudoventrally with respect to base of antennae, subspherical, shiny, easily visible from lateral and ventral aspects, diameter about twice width of base of antenna; labial palpi small, situated between basal portion of maxillae. Maxillae attached to caudoventral part of head and extending to posterior margin of fore wings, tapering distally from base; basal portion about three times as wide as distal, about one-half as long as total length of body, subequal in length to antenna.

Thorax subcylindrical with a mesal carina; appendages applied closely against body ventrally; about one-fourth as long as total length of body; pro—, meso—, and metathoraces exposed dorsally, covered by cephalic and thoracic appendages ventrally; prothorax suberescens from dorsal aspect, beset with four fine bristles dorsally; fore leg fixed between maxillae and mesothoracic legs, extending nearly half way caudally between extremities of wings, tapering distally, about two-thirds as broad and three-fifths as long as middle leg; femora of fore legs lying between maxillae and tarsi of fore leg, subfusiform. Mesothorax beset with two pairs of bristles, margins anteriorly concave, posteriorly convex, about twice as long as abdominal segment I; fore wings extending to abdominal segment IV, about one-half as long as total length of body and of nearly the same breadth as abdominal segment VII; mesothoracic legs extending caudally to posterior margin of hind wings, situated between fore leg and maxillae anteriorly and between antennae, hind wings, and hind legs caudally; metathorax subrectangular from dorsal aspect, anterior margin concave, posterior margin forming caudolateral angles with dorsolateral margins of hind wings, about as long as abdominal segment II, beset with a pair of dorsal and a pair of lateral minute bristles anteriorly, hind wings extending posteriorly beyond caudal margins of fore wings and partly seen along dorsolateral margins basally; hind legs situated between distal ends of middle legs, extending caudally beyond distal ends of maxillae.

Abdomen rugose with transverse wrinkles dorsally; subcylindrical; tapering posteriorly, as noted above; about three-fourths as long as total

length of body; ten segmented; I, II, and III exposed dorsally and covered with head and thoracic appendages ventrally; I about one-fifteenth as long as total length of body and about as long as either II or III; IV about twice as broad as long, about one and one-third times as long as III; V about one and one-fourth times as long as and nearly the same breadth as IV; VI narrower than V and about the same length of IV; VII tapering distally, about five-sevenths as long as VI; VIII tapering posteriorly, about two-fifths as long as VII; IX tapering caudally, subequal length of VIII; X about as long and two-thirds as broad as IX. II to VIII, each with a pair of spiracles; spiracles ovate, very highly chitinized and slightly elevated; III to VIII, each with one to two pairs of spines dorsally, spines situated caudally with respect to dorsal bristles; V to VII movable at transverse conjunctivae, each segment with a pair of punctures which are situated anterior to spiracles; V and VI each bearing a pair of proleg scars (circular depressions) on sterna of each segment which are situated caudomesally with respect to ventral bristles; VIII with slitlike structures representing genital openings; male genital opening (pl. 6, fig. 32) situated ventromesally, posterior to spiracles; female genital opening (pl. 5, fig. 29) ventromesally, anterior to spiracles; IX bearing ventromesal anal slit, which is similar in position in both sexes; X narrow, horny, dark posteriorly, a lateral furrow on either side, distal and bearing cremaster (pl. 6, fig. 30 and 33).

Sixth instar larva (pl. 3, fig. 9 and 10). Length (based on eighty larvae) 17 to 29 millimeters, average 22.96; width 2.8 to 4.5 average 3.32. Head capsules, length (based on four specimens) 1.85 to 2.08, average 1.96; width 18.5 to 2, average 1.94. General color, light brownish yellow. Body elongately subfusiform. Head, fuscous; ocelli, basal parts of antennae, submentum, mentum, and clypeus white; mandibles dark brown; maxillae, labium, and distal segment of antenna reddish brown. Thorax and abdomen soft, light brownish yellow dorsally with a narrow mesal laterally diffused darker yellowish brown line extending from mesonotum to subcaudal abdominal tergite, bounded on either side by hazy scattered, diffused brownish yellow patches, thence laterally by a broad diffuse area extending almost to lateral conjunctivae; verrucae, spiracles, apical portion of legs, and crochets of prolegs markedly darker yellowish brown than rest of thorax and abdomen, subunicolorous; ventral parts of thorax and abdomen brownish white; segments distinct.

Head (pl. 3, fig. 11 and 12) about five-sevenths as long as broad; subequal length and width of prothorax. Epicranium sparsely beset with setae; subspherical; slightly compressed dorsoventrally; two-thirds as thick as wide; outline from cephalic aspect broadly oval; slightly wider than long. Vertex, deeply grooved. Frons subtriangular; anterior margin straight and slightly shorter than caudolateral margin; caudolateral margin incurved ventrally at about one-third from caudal end of frons; describing an angle of about 43 degrees. Adfrons about as wide anteriorly as distal segment of

antennae; posteriorly about one and one-third times width of antennae; tapering at both extremities into acute angles. Ocelli in groups of six on either side, arranged on genae in anteriorly directed semicircle, spherical, subequal in size to one another, diameter subequal to width of distal segment of antenna, opens lateroventrally. Antennae porrect, subequal in length to mandible, situated between mandibles and anterior margin of genae, three-segmented; I subconoidal, width about two-thirds length, about one-half total length of antennae; II subannular, length about two-thirds width, about one-third as long as I; III subcylindrical, about two-thirds as wide and three times as long as II, distal end bearing three short stout spines and a long stout bristles; bristles about as long as total length of antenna. Clypeus subrectangular; posterior margin subcoextensive with anterior margin of frons; length about one-sixth width. Mouth parts occupying about one-fourth length of head. Labrum subcrenate from cephalic aspect, anterior margin emarginate mesally; about as long as and two thirds as wide as clypeus; aparsely beset with short stout setae. Mandible extending apically beyond anterior margin of labrum; about one-fourth as long as head; subtriangular; diameter at base about two-thirds length. Maxilla porrect; width at base about two-thirds basal diameter of mandible, subcylindrical, tapering distally; cardo subtriangular, about one-half as wide as long; stipes subrhomboidal, about one and one-third times as long and the same proportion in width as cardo, about one-half total length of maxilla, beset with two stout bristles; dististipes about one-fourth as long and one-third as wide as stipes; a stout bristle ventro-distally; palpifer subannular, about as long and three-fourths as broad as dististipes; a lateroventral bristle distally near base of galea; maxillary palpus two-segmented; I subconoidal, about as long as and one-half diameter of palpifer, II subellipsoidal, about two-thirds as long and nearly the same proportion in diameter as I, about as long as broad; galea about as long and one and one-third times as broad as segment I of maxillary palpus, distally two short stout and three larger subcylindrical spines, which are about one-half length and one-third width of segment II of maxillary palpus. Labium applied closely against ventral contour of head; mentum and submentum fused together forming a subrectangular plate which is concave at lateral margins, two stout bristles lateromesally midway between basal and distal margins of plate; basilabium subcrenate, about as broad and two-thirds as long as mentum; spinneret elongately subangular, about as long as mentum, width at base subequal to that of segment II of maxillary palpus; labial palpus subcylindrical, about two-thirds as long and one-third as broad as spinneret, one long and one short bristle at distal end.

Thorax subcylindrical; slightly tapering anteriorly; about one-fourth as long as total length of body; sparsely beset with setae. Prothorax (pl. 3, fig. 13) about five-sevenths as long as broad; about five-sixths as long and five-sevenths as wide as mesothorax; prothoracic shield subcrenate from

caudal aspect, caudal margin emarginate; anterior margin broadly angular anteroposteriorly. Mesothorax (pl. 3, fig. 14) about five-ninths as long as wide, about as long and about as broad as mesothorax. Metathorax (pl. 4, fig. 15) about as wide and about as long as abdominal segment I. Thoracic legs gradually decreasing in size posteroanteriorly; each leg about as long as prothorax; subconical, terminated by a claw; coxa subspherical, length about as long as breadth, bearing five bristles, trochanter subannular and about one-third as long as broad, as broad as femur; femur subcylindrical, as broad as long, about as long and one-half as wide as coxa, beset with two bristles posteriorly; tibia subcylindrical, about as long as and slightly narrower than femur, six bristles around distal margin; tarsus about two-thirds as long and the same proportion in width as tibia, four bristles near insertion of claw; claw stout, sharply pointed, arcuate ventrally.

Abdomen (pl. 4, fig. 16, 17, 18, 19, 20 and pl. 5, fig. 21, 22, 23, 24) subcylindrical; slightly tapering posteriorly; ten-segmented; abdominal segments I to VIII bearing each a pair of spiracles; spiracles oval and highly chitinized; III to VI, each with a pair of sensory pores; sensory pores (highly chitinized spots) situated caudally with respect to spiracles; II to IX with one to two strongly chitinized spots cephalad of *a* within the verruca; III, IV, V, VI and X, each with a pair of prolegs; prolegs on abdominal segments III to VI about one and one-third times as long as broad; triordinal, crochets arranged penelliptically, a dark spot at center of planta; proleg on X longer and larger than those on III to VI, inclusive, sparsely beset with bristles, crochets arranged anteriorly and occupy one-half margin of distal end. Abdominal segment I about as long and four-fifths as broad as II; II about one-half as long as broad, about five-sixths as long and nearly the same breadth as III; III about five-ninths as long as broad, about as long and nearly the same breadth as IV; IV about five-sixths as long and nearly the same breadth as V; V subequal in length and in width to VI; VI about as long as and slightly broader than VII; VII about one and one-half times as long and one-third as wide as VIII; VIII about two-thirds as long as broad, about twice as long as IX; IX about five-ninths as long as broad, subequal length and breadth of X; X bearing suranal plate; suranal plate angulate laterally; emarginate at anterior border.

Fifth instar larva (pl. 3, fig. 8). Length (based on nineteen larvae) 14 to 22 millimeters, average 18.1; width 2 to 3, average 2.5. Head capsules, length (based on two specimens) 1.33; width 1.39. Chaetotaxy, general color, and other superficial morphological characters similar to those of sixth instar, with exceptions noted below:

Head subcircular in outline at dorsal aspect; length about five-sevenths width; subequal length and breadth of prothorax.

Thorax subcylindrical; pro-, meso-, and metathoraces subequal in length and in breadth; length about five-eighths width, about one and one-sixth times as long and as wide as abdominal segment I.

Abdomen subcylindrical; slightly tapering posteriorly; I about one-half as long as wide, subequal in width and five-sixths as long as II; II five-eighths as long as broad, about as long and as broad as either III, IV, V, VI or VII, which are of subequal dimensions; VII about four-sixths as wide and as long as VIII; VIII about twice as long and one and one-third times as broad as IX, length about five-eighths width; IX about five-twelfths as long as wide, subequal length and breadth of X.

Fourth instar larva (pl. 3, fig. 7). Length (based on fifteen larvae) 11 to 17 millimeters; average 13.3; width 1.5 to 2.5, average 2. Head capsules, length (based on nine specimens) 1.1 to 1.33, average 1.22; width 1.1 to 1.3, average 1.23. Chaetotaxy, general color, and other external morphological characters similar to sixth instar, with exceptions noted below:

Head about five-sevenths as long as broad, about as long as prothorax.

Thorax with prothoracic shield subconcolorous with head; pro-, meso-, and metathoraces subequal in length and in width; length about five-eighths width, about as broad as and about one and one-fourth times as long as abdominal segment I.

Abdomen tapering posteriorly from abdominal segment VII; I about as long and five-sixths as wide as II, length about one-half width; II about one-fourth as long and as broad as III, length about five-sevenths width; III about five-ninths as long as broad, subequal in length and in width to either abdominal segments IV, V, VI, or VII, which are of subequal dimensions; VII about one and one-fifth times as wide as VIII; VIII about five-ninths as long as wide, about twice as long and one and one-fourth times as wide as IX; IX about five-fourteenths as long as wide, about five-sevenths as long and of the same width as X.

Third instar larva (pl. 3, fig. 6). Length (based on twenty-one larvae) 5 to 10 millimeters, average 7.83; width 0.8 to 1.5, average 1.1. Head capsules, length (based on seven specimens) 0.81 to 1.2, average 1.07; width 1.08 to 1.23, average 1.18. Chaetotaxy and other external morphological characters subequal to sixth instar, with exceptions noted below:

Head subcircular in outline at dorsal aspect; length about five-sixths width, about one and one-third times as long and nearly the same breadth as prothorax.

Thorax brownish white with dark brown prothoracic shield; pro-, meso-, and metathoraces subequal length and width; length about five-ninths width, about one and one-half times as long and of nearly the same breadth as abdominal segment I.

Abdomen subconcolorous to thorax dorsally and creamy white ventrally; I about five-elevenths as long as broad, subequal length and width of II; II about five-sixths as long and of the same width as III; III about five-ninths as long as broad, about as long and as broad as either IV, V, VI, or VII, which are subequal in dimensions; VIII about five-sevenths

as long as broad, subequal in length to and seven-eighths as wide as VII; IX about one-third as long as broad, about two-fifths as long and nine-elevenths as wide as VIII; X about five-ninths as long as broad, subequal in width to and one and one-third times as long as IX.

Second instar larva (pl. 3, fig. 5). Length (based on twenty-four larvae) 3.5 to 7.1 millimeters, average 5.35; width 0.6 to 1, average 0.85. Head capsules, length (based on eleven specimens) 0.80 to 0.95, average 0.86; width 0.75 to 1, average 0.86. Chaetotaxy and other external morphological characters subequal to sixth instar, with exceptions noted below:

Head subcircular in outline at dorsal aspect, dark brown, subequal length and width of prothorax.

Thorax pale yellow with dark brown prothoracic shield; pro-, meso-, and metathoraces subequal in length and in breadth, about as long and as broad as abdominal segment I.

Abdomen pale yellow dorsally and creamy white ventrally; slightly tapering posteriorly from abdominal segment VII; crochets on prolegs of III to VI, inclusive, arranged penelliptically in two rows; I about as long and as broad as either II, III, IV, V, VI, or VII, which are of subequal dimensions; VIII about two-thirds as long as broad and the same proportion in length as VII; IX about two-thirds length and breadth of VIII; X about as long as broad as IX.

First instar larva (pl. 3, fig. 4). Length, newly hatched (based on fifteen larvae) 2 to 2.8 millimeters, average 2.32; width 0.2 to 0.4 average 0.3. Length immediately prior to molting (based on twenty-one larvae) 3 to 4.6, average 3.65; width 0.4 to 0.75, average 0.53. Head capsules, length (based on seven specimens) 0.70 to 0.84, average 0.76; width 0.70 to 0.84, average 0.77. Chaetotaxy and other external morphological characters subequal to those of sixth instar, with exceptions noted below:

Head (pl. 3, fig. 3) subcircular in outline at dorsal aspect, about as long as broad, subequal in length to prothorax and about two-thirds as wide.

Thorax pale yellow with dark brown prothoracic shield; microscopic setae *alpha*, *beta*, *delta*, *epsilon*, and *tau* and setae *theta* and *sigma*, which are present in older instars, absent; pro-, meso-, and metathoraces subequal in length and in width, each about as long and as broad as abdominal segment I.

Abdomen pale yellow dorsally and creamy white ventrally; microscopic setae β and IIIa, seta μ sensory pores, and chitinated spots cephalad of α , which are present in older instars, absent; verrucae not distinct; *pi* of abdominal segments I to VI, inclusive, represented by two setae; of VII by one seta; crochets at distal ends of prolegs on III to VI, inclusive, arranged penelliptically in one row; segments I, II, III, IV, V, and VI are of subequal dimensions; VII subequal in length to and about three-fourths width of VI; VIII about three-fourths length and width of VII; IX about two-thirds as broad and one-fourth as long as VIII; X subequal length and width of IX.

Eggs (pl. 3, fig. 1 and 2). Length (based on fifty specimens) 0.72 to 1.15 millimeters, average 0.87; width 0.61 to 0.77, average 0.67; thickness 0.15 to 0.3, average 0.22. Flat; outline oval to subcircular, surface shiny. Newly laid eggs pale yellow to yellowish white, gradually changing to yellowish brown and finally to black when about to hatch. Usually in imbricated masses from six to one-hundred and thirty eggs; average, thirty-six eggs (table 3).

Life history and habits

The life history records in the present report are based on cultures carried on under insectary conditions from October, 1924, to November, 1925—a total of a little over twelve consecutive months. The data are given in tables 1, 4, 5, 6, 7, 8, and 9. The results are discussed separately under their respective headings.

Number of generations during the year. The corn borer was found to be in season throughout the year. Material could be gathered in any stage in practically any month, varying, of course, in abundance, as noted later on. The work on the determination of the number of generations was begun about the end of October, 1924. Unfortunately the cultures which closed on August 26, 1925, produced only sterile eggs, a condition which naturally broke the hitherto uninterrupted chain of generations. The stock was replenished with fresh material, which began the cycle at as close a date as possible, August 21, 1926. The work was continued to November 8, 1926. Virtually, there was no break in the line, except for change of stock.

The results are given in table 1, wherein it will be noted that during a period of one year *Pyrausta nubilalis* may pass, under laboratory conditions, through approximately nine generations. The same condition probably obtains in the field, since this species has never been found at any time to pass through any prolonged dormant stage. By way of comparison the following list of the number of annual generations of the corn borer in other countries is given:

<i>Neartic Region</i>		
<i>Countries</i>	<i>Authorities</i>	<i>Annual number of generations of the corn borer, Pyrausta nubilalis Hübner.</i>
United States:		
New York.....	Felt (1923).....	Two generations (normally)
	Barber (1925c).....	One generation
New England.....	Pettit (1925b).....	Two generations
	Drake (1926).....	Two generations
	Barber (1925c).....	Two generations
	Coffrey and Vinal (1919).....	Two generations
	Felt (1923).....	Two generations
Michigan.....	Pettit (1925b).....	One generation
Illinois.....	Flint and Malloch (1920).....	Two generations
Ohio.....	Drake (1926).....	One generation
Canada.....	Pettit (1925b).....	One generation
Ontario.....	Drake (1926).....	One generation

Palearctic Region

Russia:

Caucasus.....	Uvarov (1917).....	Two generations
Don (district).....	Dobrodeiv (1921).....	Two generations
Veronezh.....	Dobrodeiv (1921).....	One generation
Italy.....	Caffrey and Worthley (1927).....	Two generations
Hungary.....	Worthley.....	One generation
Belgium.....	Worthley.....	One generation

France:

Toulouse.....	Rives (1919).....	Two generations
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Oriental Region

Philippine Islands:

Los Baños.....	Present report.....	Nine generations
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Length of life cycle. Table 1 shows that the life cycle differs in duration with the time of the year. The minimum was found to be 32 days, in May and June, 1925; the maximum 53 days, in November and December, 1924; the lowest average, 35.6 days, in June and the first half of July, 1925; and the highest, 50.5 days, in September to November, 1925. The shortest life cycle occurred during the latter part, covering more than half, of the dry season, when the temperature rose to a maximum of 33°C. in May, 1925. The longest life cycle occurred during the rainy season, especially at the time when the monsoons brought from northern latitudes low temperatures. A tentative conclusion is therefore drawn that high temperatures in combination with other climatic factors prevailing at the time under consideration rendered the life cycle, under laboratory conditions, short, and conversely, low temperatures, in combination with high average precipitation, lengthened it. This condition may be interpreted as being partly caused by high temperature accelerating chemical reactions in the body of the developing insect and low temperature retarding them. The insect spends the larval and pupal stages inside the plant so that it would be less likely to suffer from direct effect of drastic climatic changes than if it were an exophagous species. The short duration of life cycle therefore can not be taken as an index of favorable conditions for growth of *Pyrausta*.

Emergence and copulation. The newly emerged moth has its wings crumpled. It takes five to ten minutes for the appendages to straighten.

In captivity, the adults spend most of the time resting on the underside of the cloth cover and on the walls of the battery jar. They occasionally move to the wet pellet of cotton to drink. Under natural conditions in the field, they hide under the leaves of the corn plant and in most cases under the leaves of weeds in the corn field and vicinity during the day time. They begin to fly at dusk.

The male and the female copulate within a day after emergence. Mating usually occurs at from three to five o'clock in the morning. The process lasts usually for from fifteen to twenty minutes. During copulation, the female and the male face in opposite directions and join the caudal ends of

the abdomen. The body of the male is usually flexed downward. The outer margins of the wings of the female overlap those of the male. They are both at rest when in copula.

Observation on several couples both during the day and during the night seemed to indicate that copulation takes place only once during the life of the female. For confirmation controlled experiments were performed. In one set the males were kept with the females and left until one died and in the other set the males were removed soon after the first batch of fertile eggs were laid. The results are given in table 2. In both cases the eggs were invariably fertile, since they hatched in time. Moreover, the subsequent removal of the male did not seem to interfere with the total number of eggs deposited by the female.

Time, place, and manner of oviposition. The female lays eggs in the evening, apparently between seven and twelve o'clock. In cases the writer had a chance to observe, the process first occurred in from one to three days after emergence (table 4) and about nineteen hours after copulation. While ovipositing, the female was at rest with the caudal end of the abdomen bent downward and swaying alternately to right and left as she advanced forward by degrees. The eggs were found in a few cases to be deposited at the rate of about ten per minute. They were laid either singly or in masses of two to two hundred on the walls of the containing jar or on the underside of the cloth cover. Under natural conditions, the females deposited eggs in imbricated fashion (pl. 3, fig. 2) in masses of from six to one hundred thirty with an average of 36.28 (see table 3) on the nether (pl. 1, right) surfaces of corn leaves. The fifth to tenth leaves seemed to be preferred. In rare cases eggs were laid on the upper surface of the leaf.

The insect does not seem to have seasons for oviposition. This statement is borne out by the fact that infestation usually begins at the tasseling stage and continues up to the glazing stage of the corn plant in any month of the year (table 10). In general, however, there are only two corn growing seasons in most parts of the Islands; in regions represented by Los Baños and vicinity, from May to August in the rainy season, and from October to December in the dry season.

Longevity of adults and period of fecundity. Under laboratory conditions, during the period from the end of October to about the end of December, 1924, and from the middle of March to the end of April, 1925, the adults were found to remain alive in captivity as follows (see tables 5 and 6):

Males 2 to 16 days; average 8.34

Females 2 to 19 days; average 8.5

It will be noted that there was but little difference under laboratory conditions between longevity in the adult stage of the male and of the female. The adult females were slightly longer lived. There was no evident difference between length of adult life in the dry season and in the

rainy. Purposely no food was given, although perhaps the adults were able to sip some of the sweet juice that exuded from the cut ends of corn stalks in the jar. Plenty of water was supplied in wet pellets of cotton.

In captivity, the female was found to lay eggs through a period of from 1 to 12 days; average 5.43 days (table 7). She either died while still fecund or survived her egg-laying period by a maximum of 5 days; average 1.94 days (table 5).

Daily and total oviposition record of individual females. The rate of daily egg-laying was irregular as shown in table 9. In a number of cases, days of active oviposition were followed by one or more days in which no eggs were laid. After this short rest, the process was resumed with renewed vigor. The number laid daily varied from 0 to 365, with an average of 77.6. The total number of eggs laid during the life of the female varied from 115 to 1193, with an average of 465.2.

Incubation period. The incubation period varied from 4 to 5 days, with an average of 4.33 (table 1). It was found that eggs in a given mass hatched at the same time. On account of the small number of egg masses observed, no very definite conclusions can be made as to effect of climatic factors on incubation.

Duration of larval stage and stadia and habits of larvae. On hatching, the larva cuts an irregular opening through the chorion and crawls out. The newly hatched caterpillar feeds on the epidermis of the tender leaf blades near the place of hatching. Subsequently, however, it migrates to some other parts of the plant and eats its way into the stalk, where a leaf sheath covers it. Some individuals gain entrance into the flower buds in the tassel, while others may be blown by the wind while crawling and in this way succeed in reaching other corn plants. The most common point of attack is at or near the nodes of the stalk, where the plant tissue is tender. It seems probable that the larvae do not remain in one tunnel, but crawl out from time to time and bore into fresh parts of the same plant, or as is more frequently the case, of another. This supposition is based on the fact that although the earlier instars were found in large numbers in tunnels within one plant, yet in no instance were the older larvae particularly numerous. Moreover, in the field full grown caterpillars were found to have bored fresh tunnels into corn stalks and ears (pl. 1. (*left*) and pl. 2).

The presence of the corn borer may be detected by the trash collecting at the opening of the tunnels. Another easily noticeable sign of infestation is broken tassels with accumulated trash at the cut ends. Prevalence of attacked ears also furnish tell-tale clues. The tunnels are usually directed upward. In most cases only one larva inhabits a tunnel.

Severely attacked plants may harbor as many as sixteen larvae of different ages, and even pupae, in the stalk. A maximum of three larvae was found infesting each internode.

Molting is carried on inside the tunnels. In the first and second instars, the act does not seem to interfere with feeding, save in the actual process of shedding the exuviae. In the subsequent instar, however, the larvae may cease feeding for as long as twelve hours preparatory to ecdysis. They then become somnolent and inactive, lying on one side, with the body conspicuously flexed ventrally. The skin then splits dorsomesally at the thorax and by continuous bending and wriggling the caterpillar soon extricates itself from the old skin. The freshly molted larva of the later instars needs about six hours to harden the body parts sufficiently to feed.

Preliminary to pupation, the full-grown caterpillar moves to the lower end of the tunnel, near the opening. The burrow behind is then plugged with compacted trash and loose silken strands spun across the opening. Sometimes the larva encloses itself in a thin cocoon, but very often this structure is dispensed with. The final position on pupating is with the head directed downward.

Occasionally the larva goes clear out of the tunnel and pupates among the ear husks. In this position, it invariably incloses itself in a cocoon.

The larval stage varies from 18 to 41 days, with an average of 28.89 (table 10). The smallest average in the nine generations studied, 21 days, was between June 4 and July 11, 1925, and the largest 33.95, between October 29 and December 18, 1924.

There are six larval stadia, lasting as follows:

First stadium 2 to 6 days; average 3.55

Second stadium 2 to 5 days; average 3.56

Third stadium 3 to 6 days; average 3.78

Fourth stadium 3 to 6 days; average 3.87

Fifth stadium 3 to 7 days; average 4.64

Sixth stadium 4 to 21 days; average 11.48

It will be seen from the foregoing averages that there is a very slight progressive increase in duration from the first to the fourth stadium; the fifth stadium is longer than the fourth by a little less than a day; and the sixth is more than double the fifth.

The pupal stage ranges from 5 to 12 days, with an average of 8.3.

Seasonal occurrence and abundance. The corn borer occurred throughout the years 1925 and 1926 in the College of Agriculture Experiment Station, Los Baños, and on the neighboring farms. In the vicinity of the College of Agriculture, cropping of corn was continuous throughout these two years except from October to December, 1925, when the plant was very scarce. During this interval of time, the corn borer was found feeding on sorghum. The area planted to corn varied in size from season to season and when the planting was small the intensity of infestation was naturally great. The relation of the degree of infestation to the growth stages of corn is given in table 10. In this table, it will be seen that corn becomes susceptible to corn borer infestation from tasseling

to glazing. This was almost invariably true, the only exception being an isolated case on June 18, 1925, of a corn field belonging to the Animal Husbandry Department which was infested before the plants tasselled. The pest was especially abundant from May to September in both 1925 and 1926 and several corn fields showed from 50 to 98 per cent infestation.

Susceptibility of different corn varieties. There are two varieties of corn grown in the College Farm and vicinity. The Native Yellow Flint was extensively planted at the College of Agriculture and on neighboring farms. Small areas in the Experiment Station ground were planted to sweet corn. These two varieties were found to be equally susceptible to the attack of the pest, but the vigorous healthy plants with large stalks of either variety were relatively more resistant to the injury of the corn borer. Very likely no corn variety is immune, for as reported by Drake (1926) in the United States, all varieties are susceptible to attack.

Alternative hosts. Sorghum was found attacked by the corn borer from October to December in 1925 when little corn was grown in Los Baños. Sorghum was grown continuously in all the seasons of 1925 and 1926, but it was free from corn borer infestation when corn was grown in large quantities. This fact indicates that corn is preferred to sorghum. Woodworth (1921) reports that corn, sorghum, millet, and *Panicum* spp. are the hosts of corn borer in the Philippines. Exhaustive search by the writer has failed so far to reveal any indication of attack by corn borer on our common species of *Panicum*.

Drake (1926) states that over two hundred species of plants are infested in the United States; but some of these hosts serve only to a limited extent as breeding plants. The others form temporary food or shelter plants for the winter. In Europe and Asia, the favorable breeding plants are reported to be chiefly hemp, hops, broom corn, millet, and certain wild grasses where there is no maize, but after this plant is introduced, it becomes the preferred host. Pettit (1925b) notes that corn is the first choice, then sorghum and other relatives.

During the course of the present work, no plants, either wild or cultivated, other than corn and sorghum were found attacked by the corn borer at any time.

Natural enemies

The following natural enemies were collected during the course of the present work. Many of the species have not yet been determined and are here reported by accession numbers. They are being sent to various specialists, who, it is hoped, will report on them in the near future. For a tabulated list, see table 11.

a. Enemies of larvae (table 11)

- (1) Parasites: Acc. Nos. Ec 187 (*Chelonus communis* Baker (MS), Braconidae), Ec 186, Ec 195, Ec 197, Ec 198, and Ec 196 (*Xanthopimpla stemmator*)⁴, Ichneumonidae).

⁴Determined by R. A. Cushman

- (2) Predators: Acc. Nos. Ec 190 (*Phemius tibialis* Westwood, Harpactoridae), Ec 191 (*Sphodronyttus erythropterus* Burm., Harpactoridae), Ec 192 (*Proreus simulans* Stal., Chelisochidae), Ec 194 (*Carpophilus foveicollis* Murr., Histeridae).

b. *Enemies of pupae* (table 11)

- (1) Parasites: Acc. Nos. Ec 188 (*Chalcis euploae* Hope⁵, Chalcididae), Ec 189, and Ec. 361.
- (2) Predators: Acc. Nos. Ec 191 (*Sphodronyttus erythropterus* Burm., Harpactoridae), Ec 193, and Ec 194 (*Carpophilus foveicollis* Murr., Histeridae).

In America and in Europe, *Pyrausta nubilalis* has many known parasites, owing to more extensive work done on this pest in those continents. A list is given below:

Locality	Authorities	Parasites	Parasites of	Source
United States:				
New England..	Barber (1925a) ..	<i>Trichogramma minutum</i> Riley.	Eggs...	Autochthonous
Massachusetts.	Caffrey and			
	Vinal (1919) ..	<i>Masicera myoidea</i> Desv.	Larvae..	"
		<i>Phorocera erecta</i> Coq.	Larvae..	"
		<i>Exorista pyste</i> Walk.	Larvae..	"
		<i>E. nigripalpis</i> Towns.	Larvae..	"
		<i>Amblyteles brevicinctus</i> Say.	Pupae...	"
		<i>Epiurus pterophori</i> Ashm.	Pupae...	"
United States..	Caffrey (1925) ..	<i>Angitia punctoria</i> Roman.		Imported from Europe
		<i>Exeristes roborator</i> Fabr.		"
		<i>Microgaster tibialis</i> Nees.		"
		<i>Phaogenes planifrons</i> Wesm.		"
		<i>Eulimneria crassifemur</i> Thom.		"
		<i>Zenillia roseanae</i> B. and B.		"
		<i>Habrobracon brevicornis</i> Wesm.		"
France.....	Vuillet (1919) ..	<i>Lydella stabulans</i> Mq.		Autochthonous
		<i>Paraphorocera senilis</i> Rond.		"
France.....	Poutiers (1922) ..	<i>Eulimneria crassifemur</i> Thom.		"
		<i>Habrobracon brevicornis</i> Wesm.		"
		<i>Masicera senilis</i> Rond.		"
		<i>Rhogas testaceus</i> L. A.	Eggs...	"
		<i>Trichogramma semblidis</i> Auriv.	Eggs...	"
		<i>Zenillia roseanae</i> B. and B.		"
Russia.....	Dobrodeiv (1920) ..	<i>Ceromasia interrupta</i>		"
Italy.....	Caffrey and Wor-			
	thley (1927) ..	<i>Dezodes nigripes</i> Fall.	Larvae..	"
		<i>Eulophus</i> sp.	Larvae..	"

SUMMARY AND CONCLUSIONS

1. The corn borer, *Pyrausta nubilalis* Hübn. (Pyralidae, Pyraustinae, Lepidoptera), is one of the worst pests of corn in the Philippines.

2. This species is known under fourteen synonyms (Caffrey and Worthley, 1927) as follows: *Pyrausta nubilalis* Hübn., *Pyralis nubilalis* Hübn., *Pyralis silacealis* Hübner, *Pyralis glabralis* Haworth, *Botys sila-*

⁵ Determined by C. F. Baker

cealis Freyer, *Botys lupulinalis* Guenee, *Botys zealis* Guenee, *Botys nubilalis* Lederer, *Botys lupulina* Heinemann, *Hapalia kasmirica* Moore, *Hapalia lupulina* Butler, *Pyrausta nubilalis* Meyrick, *Pyrausta polygona* Dyar, *Pyrausta vastatrix* Schultze.

3. This insect is practically cosmopolitan, having been reported from all the zoögeographical regions, except the Australian and the Ethiopian. It is a native of the Old World, and is a recent immigrant in the New, where it was first introduced into the United States and Canada in 1909 and 1910 (Caffrey and Worthley, 1920).

4. Very little is known concerning the life history of the corn borer in the Philippine Islands. Considerable work on this pest has been done in Canada, United States, and Europe.

5. *Pyrausta nubilalis* occurs in all seasons in the College of Agriculture Experiment Station and vicinity. It usually infests corn at the stage from tasseling to glazing in the growth of the plant. It was found feeding on sorghum from October to December, 1925, when the corn plant was very scarce.

6. Indications of an infested corn field are broken tassels, presence of trash which collects at the openings of tunnels, and characteristic appearance of attacked ears.

7. Infestation of the corn crop on the College Campus and vicinity from October 4, 1924, to December 26, 1926, varied from 2 to 90 per cent, with an average of 50.5 per cent. The infestation of the corn fields by this insect from May to September in both 1925 and 1926 varied from 50 to 98 per cent. The greater intensity of infestation usually occurred during the time when the area planted to corn was small.

8. The two varieties of corn (Native Yellow Flint and Sweet Corn) planted at the College of Agriculture and on neighboring farms were found to be equally susceptible to the attack of this pest.

9. During the course of the present work, only corn and sorghum were found attacked by the corn borer. Sorghum was free from corn borer infestation when corn was grown in large quantities. This fact indicates that corn is preferred to sorghum as host.

10. All the stages (eggs, larvae, pupae, and adults) of the corn borer are oftentimes present concurrently in heavily infested corn fields.

11. Under natural conditions, the adults hide under the leaves of the corn plants and in the grass during the day. They begin to fly at dusk.

12. Under laboratory conditions, mating usually occurred at from three to five o'clock in the morning. The female laid eggs in the evening, usually about nineteen hours after copulation.

13. The female was found to lay eggs in masses of from 6 to 130 eggs; average 36.28 eggs, on the underside of the fifth to the tenth leaves

of corn. In the laboratory, the eggs were deposited on the walls and covers of the containing jars in masses of from 1 to 200 eggs.

14. The full grown larvae pupate in the tunnel just behind the opening, and sometimes among the ear husks.

15. Larvae at the earlier stage feed on the epidermis of the corn leaves and on the tassels and subsequently bore tunnels in the midribs and in the tender portion of the stalks. As they grow older, they migrate to and bore tunnels in the stalks and ears of the same or of other corn plants in the field. The tunnels extend to the lower portion of the stalks to about five centimeters above the surface of the ground.

16. Each tunnel was as a rule occupied by a single larva. As many as sixteen larvae of different ages were found in the stalk of a severely attacked corn plant. A maximum of three larvae were found infesting each internode.

17. There are six larval instars. Molting occurred within the tunnel.

18. Life history of the corn borer:

a. Incubation period, from 4 to 5 days; average, 4.33 days.

b. Larval stage, 18 to 41 days; average 28.89 days.

First stadium, 2 to 6 days; average 3.35 days.

Second stadium, 2 to 5 days; average 3.56 days.

Third stadium, 3 to 6 days; average, 3.78 days.

Fourth stadium, 3 to 6 days; average, 3.87 days.

Fifth stadium, 3 to 6 days; average, 4.64 days.

Sixth stadium, 4 to 21 days; average, 11.48 days.

c. Pupal stage, 5 to 12 days; average, 8.3 days.

d. Egg to emergence of adult 29 to 56 days; average, 41.47 days.

e. Life cycle 32 to 53 days, average, 43.69 days. The minimum life cycle occurred during the latter part, covering more than half, of the dry season, when the temperature rose to a maximum of 33°C.; and the maximum life cycle was during the rainy season when the temperature was low, in combination with high average precipitation.

19. This pest went through at least nine generations a year in the Philippine Islands. In the United States, Canada, Russia, Italy, Hungary, Belgium, and France, the insect has only one to two generations a year.

20. Longevity of adults: Male 2 to 16 days, average, 8.34 days; female 2 to 19 days, average, 8.5 days.

21. Copulation occurred within a day after emergence of the adults. The process took place once during the life of the female.

22. The time elapsing from the emergence of the female to first oviposition was from 1 to 3 days; with an average of 1.5 days.

23. The period of fecundity was from 1 to 12 days; average, 5.43 days.

24. The female survived its period of fecundity by from 0 to 5 days; average, 1.94 days.

25. The number of eggs laid daily by each female during the entire egg-laying period varied from 0 to 365 eggs, with an average of 77.6.

26. The total number of eggs laid by each female during the entire egg-laying period varied from 115 to 1,193, with an average of 465.2 eggs.

27. The natural enemies of the corn borer observed during the course of the present work in the College of Agriculture, Los Baños and vicinity: nine species of Hymenopterous parasites, including *Chelonus communis* Baker (MS), *Xanthopimpla stemmator*, and *Chalcis euplocae* Hope; two species of Hemipterous predators, *Pemius tibialis* Westwood and *Sphodronyttus erythropterus* Burm; one species of Coleopterous predator, *Carpophilus forelcollis* Murr., one Dermapterous predator, *Proreus simulans* Stal.; and one Hymenopterous predator.

RECOMMENDATIONS

The following control suggestions are deduced from results reported in the present paper. Valuable pointers on control were also obtained from Caffrey (1922), Caffrey and Worthley (1927), Drake (1926), Huber and Neiswander (1924, 1927), and Pettit (1925).

1. Maintenance of healthy plants. Vigorous, healthy plants with large stalks suffer less than weak ones from injury from the attack of this insect.

2. Crop rotation and regulation of time of planting. Corn and other host plants of *Pyrausta* should be planted at approximately the same time in a given locality. The aim is to starve the pest by preventing it from getting access to suitable food at certain periods of the year.

3. Corn, sorghum, millet, and *Panicum* spp. are the known hosts of *Pyrausta* in the Philippines. *Panicum* is represented by several species of wild grasses; these should be eliminated from the field and vicinity so far as possible by thorough cultivation.

4. Infested corn plants should be cut close to the ground and fed to animals. That which is not eaten in the stables should be burned or buried so as to destroy all the larvae and pupae which may be present therein.

5. The stubble left on the ground should be plowed under as soon as practicable, even in fields which may not show signs of infestation.

6. These measures recommended are for the purpose of eliminating so far as practicable the possible sources of infestation, so as to protect subsequent crops. There must be wide-spread co-operation among all the farmers in a given locality. Combined efforts of a large community in this direction can easily be offset by a careless or indifferent corn planter in the neighborhood.

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ILLUSTRATIONS

(Magnifications indicated refer to size of original figures)

PLATE 1

Left. Corn ear partly exposed to show work of corn borer larvae.
Right. Egg mass *in situ* on nether surface of corn leaf.

PLATE 2

Portion of corn stem and ears showing work of corn borer larvae.

PLATE 3

- Fig. 1. Egg, $\times 123$
 2. Egg mass, $\times 20.5$
 3. Head, first instar, $\times 123$
 4. First instar, lateral aspect, $\times 7.5$
 5. Second instar, lateral aspect, $\times 7.5$
 6. Third instar, lateral aspect, $\times 7.5$

7. Fourth instar, lateral aspect, $\times 7.5$
8. Fifth instar, lateral aspect, $\times 7.5$
9. Sixth instar, lateral aspect, $\times 7.5$
10. Sixth instar, dorsal aspect, $\times 7.5$
11. Head, sixth instar, lateral aspect, $\times 40$
12. Head, sixth instar, cephalic aspect, $\times 40$
13. Prothorax, sixth instar, lateral aspect, $\times 40$
14. Mesothorax, sixth instar, lateral aspect, $\times 40$

PLATE 4

15. Metathorax, sixth instar, lateral aspect, $\times 40$
16. Abdominal segment I, sixth instar, lateral aspect, $\times 40$
17. Abdominal segment II, sixth instar, lateral aspect, $\times 40$
18. Abdominal segment III, sixth instar, lateral aspect, $\times 40$
19. Abdominal segment IV, sixth instar, lateral aspect, $\times 40$
20. Abdominal segment V, sixth instar, lateral aspect, $\times 40$

PLATE 5

21. Abdominal segment VI, sixth instar, lateral aspect, $\times 40$
22. Abdominal segment VII, sixth instar, lateral aspect, $\times 40$
23. Abdominal segment VIII, sixth instar, lateral aspect, $\times 40$
24. Abdominal segment IX and X, sixth instar, lateral aspect, $\times 40$
25. Pupa, lateral aspect, $\times 7.5$
26. Pupa, ventral aspect, $\times 7.5$
27. Pupa, dorsal aspect, $\times 7.5$
28. Abdominal segments VII to X of female pupa, lateral aspect, $\times 40$
29. Abdominal segments VII to X of female pupa, ventral aspect, $\times 40$

PLATE 6

30. Abdominal segment X of female pupa, showing cremaster, lateral aspect, $\times 80$
31. Abdominal segments VII to X of male pupa, lateral aspect, $\times 40$
32. Abdominal segments VII to X of male pupa, ventral aspect, $\times 40$
33. Abdominal segment X of male pupa, showing cremaster, lateral aspect $\times 80$
34. Adult male, dorsal aspect, $\times 8$
35. Adult female, dorsal aspect, $\times 8$
36. Female, wings expanded, dorsal aspect, $\times 8$
37. Head of adult male, scales and antennae partly removed, cephalic aspects, $\times 28$

PLATE 7

38. Antenna of adult male, lateral aspect, $\times 28$
39. Fore wing of adult male, $\times 16$
40. Hind wing of adult male, $\times 16$
41. Fore leg of adult male, $\times 14$
42. Middle leg of adult male, $\times 14$
43. Hind leg of adult male, $\times 14$
44. Male genitalia, ventral aspect (harpes partly spread out), $\times 44$

PLATE 8

45. Male genitalia, dorsal aspect (harpes partly spread out), $\times 44$
46. Penis *in situ* within aedeagus, $\times 160$
47. Penis, $\times 160$
48. Abdominal segments VII to X of female, showing ovipositor, ventral aspect, $\times 80$
49. Ovipositor, ventral aspect, $\times 40$
50. Ovipositor, lateral aspect, $\times 40$

CLE G)	Max. days
	53
	52
	52
	50
	47
	37
	50
	39
	52

TABLE 2
Number of copulations during life of female

SET I					SET II					
Confined male (♂) and female (♀)	Male and female separated			Total number of eggs laid during entire laying period	Fertile (f) or in-fertile (i)	Male and female confined	First oviposition	Male and female separated	Total number of eggs laid during entire laying period	Fertile (f) or in-fertile (i)
	Date	Remarks								
		♂	♀							
1924	1924					1925	1925	1925		
29-X	6-XI	D	D	975	f	17-III	17-III	18-III	316	f
30-X	5-XI	D	—	620	f	18-III	18-III	19-III	339	f
30-X	9-XI	D	—	434	f	19-III	19-III	20-III	203	f
4-XI	10-XI	D	—	411	f	19-III	19-III	20-III	342	f
4-XII	10-XII	D	D	790	f	21-III	21-III	22-III	197	f
9-XII	11-XII	D	D	245	f	21-III	22-III	23-III	115	f
9-XII	16-XII	—	D	256	f	20-III	22-III	23-III	210	f
9-XII	23-XII	D	D	1061	f	28-III	28-III	29-III	433	f
10-XII	17-XII	D	—	218	f	29-III	29-III	30-III	416	f
12-XII	17-XII	D	—	581	f	29-III	29-III	30-III	872	f
14-XII	23-XII	—	D	519	f	1-IV	1-IV	2-IV	257	f
16-XII	19-XII	D	—	258	f	4-IV	5-IV	6-IV	433	f
16-XII	24-XII	—	D	436	f	3-IV	4-IV	5-IV	549	f
16-XII	21-XII	D	—	331	f	11-IV	14-IV	15-IV	527	f
16-XII	21-XII	—	D	198	f	11-IV	13-IV	14-IV	506	f
—	—	—	—	—	—	11-IV	14-IV	15-IV	647	f
—	—	—	—	—	—	21-IV	22-IV	23-IV	1193	f
Minimum.....		—	—	198	—	—	—	—	115	—
Maximum.....		—	—	1061	—	—	—	—	1193	—
Average.....		—	—	488.8	—	—	—	—	444.4	—

TABLE 3

Place of oviposition of the corn borer under natural condition

DATE COLLECTED	NUMBER OF EGGS IN MASS	LOCATION ON CORN PLANT		
		Leaf surface	Distance from the base of the leaf	Leaf number from the base of plant
1925			cm.	
1-III	21	nether	20.0	7
1-III	32	"	19.0	6
1-III	6	"	10.0	8
1-III	23	"	24.0	9
1-III	24	"	30.0	9
1-III	23	"	35.0	8
1-III	43	"	10.0	10
2-III	26	upper	22.0	7
2-III	24	nether	50.0	6

TABLE 4

Time from emergence of female to laying of first batch of eggs

CULTURE NO.	ADULTS EMERGED	FIRST EGGS LAID	TOTAL
	1924	1924	<i>days</i>
1	29-X	31-X	2
2	30-X	31-X	1
3	30-X	1-XI	2
4	4-XI	7-XI	3
5	4-XII	5-XII	1
6	8-XII	9-XII	1
7	8-XII	9-XII	1
8	9-XII	10-XII	1
9	10-XII	12-XII	2
10	12-XII	13-XII	1
11	14-XII	16-XII	2
12	15-XII	16-XII	1
13	16-XII	17-XII	1
14	15-XII	16-XII	1
15	16-XII	18-XII	2
	1925	1925	
16	16-III	17-III	1
17	17-III	18-III	1
18	18-III	19-III	1
19	18-III	19-III	1
20	19-III	21-III	2
21	20-III	22-III	2
22	20-III	22-III	2
23	27-III	28-III	1
24	28-III	29-III	1
25	28-III	29-III	1
26	31-III	1-IV	1
27	3-IV	5-IV	2
28	3-IV	4-IV	1
29	11-IV	14-IV	3
30	11-IV	13-IV	2
31	11-IV	14-IV	3
32	21-IV	22-IV	1
Minimum	—	—	1
Maximum	—	—	3
Average	—	—	1.5

TABLE 5

Longevity of adult females

CULTURE NO.	DATE EMERGED	DATE DIED	LONGEVITY
	1924	1924	<i>days</i>
1	29-X	6-XI	8
2	30-X	7-XI	8
3	30-X	12-XI	13
4	4-XI	11-XI	7
5	4-XII	10-XII	6
6	9-XII	11-XII	2
7	9-XII	15-XII	6
8	9-XII	23-XII	14
9	10-XII	21-XII	11
10	12-XII	26-XII	14
11	14-XII	23-XII	9
12	16-XII	23-XII	7
13	16-XII	23-XII	8
14	16-XII	24-XII	8
15	16-XII	21-XII	5
	1925	1925	
16	17-III	24-III	7
17	18-III	24-III	6
18	19-III	25-III	6
19	19-III	26-III	7
20	19-III	24-III	5
21	20-III	25-III	5
22	20-III	25-III	5
23	28-III	6-IV	9
24	29-III	4-IV	6
25	29-III	10-IV	12
26	31-III	5-IV	5
27	3-IV	10-IV	7
28	3-IV	9-IV	6
29	11-IV	27-IV	16
30	11-IV	26-IV	15
31	11-IV	30-IV	19
32	21-IV	1-V	10
Minimum	—	—	2
Maximum	—	—	19
Average	—	—	8.5

TABLE 6

Longevity of adult males

CULTURE NO.	DATE EMERGED	DATE DIED	LONGEVITY
	1924	1924	days
1	29-X	6-XI	8
2	30-X	5-XI	6
3	30-X	9-XI	10
4	4-XI	10-XI	6
5	4-XII	10-XII	6
6	9-XII	11-XII	2
7	9-XII	17-XII	8
8	9-XII	23-XII	14
9	6-XII	17-XII	11
10	12-XII	17-XII	5
11	14-XII	24-XII	10
12	14-XII	19-XII	5
13	16-XII	25-XII	9
14	16-XII	21-XII	5
15	16-XII	23-XII	7
	1925	1925	
16	17-III	21-III	4
17	18-III	23-III	5
18	16-III	23-III	7
19	16-III	21-III	5
20	20-III	25-III	5
21	20-III	25-III	5
22	20-III	25-III	5
23	28-III	5-IV	8
24	29-III	14-IV	16
25	29-III	12-IV	14
26	2-IV	9-IV	7
27	2-IV	7-IV	5
28	3-IV	8-IV	5
29	11-IV	27-IV	16
30	11-IV	27-IV	16
31	11-IV	27-IV	16
32	21-IV	7-V	16
Minimum	—	—	2
Maximum	—	—	16
Average	—	—	8.34

TABLE 7

Period of fecundity

CULTURE NO.	FIRST EGGS LAID	LAST EGGS LAID	TOTAL
	1924	1924	days
1	31-X	5-XI	5
2	31-X	5-XI	5
3	1-XI	10-XI	9
4	7-XI	9-XI	2
5	5-XII	9-XII	4
6	9-XII	10-XII	1
7	9-XII	13-XII	4
8	10-XII	19-XII	9
9	12-XII	20-XII	8
10	13-XII	22-XII	9
11	16-XII	22-XII	6
12	16-XII	21-XII	5
13	17-XII	23-XII	6
14	16-XII	23-XII	7
15	18-XII	19-XII	1
	1925	1925	
16	17-III	23-III	6
17	18-III	22-III	4
18	19-III	23-III	4
19	19-III	23-III	4
20	21-III	24-III	3
21	22-III	24-III	2
22	22-III	24-III	2
23	28-III	4-IV	7
24	29-III	3-IV	5
25	29-III	6-IV	8
26	1-IV	3-IV	2
27	5-IV	8-IV	3
28	4-IV	8-IV	4
29	14-IV	26-IV	12
30	13-IV	22-IV	9
31	14-IV	25-IV	11
32	22-IV	29-IV	7
Minimum	—	—	1
Maximum	—	—	12
Average	—	—	5.43

TABLE 8

Time from laying of last eggs to death of female

CULTURE NO.	LAST EGGS LAID	DEATH OF FEMALE	TOTAL
	1924	1924	<i>days</i>
1	5-XI	6-XI	1
2	5-XI	7-XI	2
3	10-XI	12-XI	2
4	9-XI	11-XI	2
5	9-XII	10-XII	1
6	10-XII	11-XII	1
7	13-XII	15-XII	2
8	19-XII	23-XII	4
9	20-XII	21-XII	1
10	22-XII	26-XII	4
11	22-XII	23-XII	1
12	21-XII	23-XII	2
13	23-XII	24-XII	1
14	23-XII	24-XII	1
15	19-XII	21-XII	2
	1925	1925	
16	23-III	24-III	1
17	22-III	24-III	2
18	23-III	25-III	2
19	23-III	26-III	3
20	24-III	24-III	0
21	24-III	25-III	1
22	24-III	25-III	1
23	4-IV	6-IV	2
24	3-IV	4-IV	1
25	6-IV	10-IV	4
26	3-IV	5-IV	2
27	8-IV	10-IV	2
28	8-IV	9-IV	1
29	26-IV	27-IV	1
30	22-IV	26-IV	4
31	25-IV	30-IV	5
32	29-IV	1-V	2
Minimum	—	—	0
Maximum	—	—	5
Average	—	—	1.94

TABLE 10

Dates of initial infestation, degrees, and ages of susceptibility of the corn plant

DATE OF INITIAL INFESTATION	SUSCEPTIBLE AGE OF THE CORN PLANT	DEGREE OF INFESTA- TION AS DETERMIN- ED ON HAR- VESTING	LOCALITY
1924			
	<i>Stages</i>	<i>Percent</i>	
Oct. 4	From tasseling to glazing ^a	80	Anos, Los Baños
Oct. 6	" " "	80	Anos, Los Baños
Dec. 15	" " "	75	San Antonio, Los Baños
1925			
Jan. 1	" " "	60	San Antonio, Los Baños
Jan. 9	" " "	60	San Antonio, Los Baños
Jan. 15	" " "	60	South of Animal Husbandry building
Jan. 28	" " "	70	East of the hill in the Experiment Station
Jan. 28	" " "	60	San Antonio, Los Baños
Feb. 2	" " "	50	Copeland Heights
Feb. 5	" " "	60	Animal Husbandry (near the hill)
Feb. 14	" " "	70	Anos, Los Baños
Feb. 15	" " "	50	East of the hill in the Experiment Station
Feb. 15	" " "	60	East of the hill in the Experiment Station
Feb. 15	" " "	5	Copeland Heights
Feb. 17	" " "	7	Animal Husbandry (lot near hill)
March 1	" " "	50	Back of Auditorium
March 7	" " "	98	Back of Protestant Chapel
June 8	From before tasseling to glazing	50	Animal Husbandry (near hill)
July 1	From tasseling to glazing	60	Animal Husbandry (near hill)
July-Sept.	" " "	90	Between Chemistry building and Audi- torium
Sept. 6	" " "	80	Near Auditorium
1926			
Jan. 1	" " "	5	Near Y. M. C. A. building
Jan. 15	" " "	2	Maajas, Los Baños
Jan. 16	" " "	2	Bay, Laguna
March 18	" " "	6	Animal Husbandry (lot near hill)
March 19	" " "	8	Animal Husbandry (near Poultry House)
April 10	" " "	98	Near Poultry House
July 10	" " "	86	Experiment Station
July 18	" " "	6	Near Main Building (C. A.)
July 22	" " "	50	Near Y. M. C. A. building
Aug. 22	" " "	70	Near Y. M. C. A. building
Sept. 13	" " "	80	Experiment Station
Oct. 16	" " "	70	Experiment Station
Nov. 10	" " "	50	San Antonio, Los Baños
Dec. 10	" " "	30	San Antonio, Los Baños
Dec. 10	" " "	10	San Antonio, Los Baños
Dec. 26	" " "	20	San Antonio, Los Baños

^aEars at stage suitable for roasting.

TABLE 11

Natural enemies of Pyrausta nubilalis Hüb. in the Philippines

ACC. NO.	STAGE PARASITIZED OR PREYED UPON	SCIENTIFIC NAME	FAMILY	ORDER
Ec 186	Larva		Braconidae	Hymenoptera
Ec 187	"	Chelonus communis Baker (MS).....	Braconidae	Hymenoptera
Ec 196	"	Xanthopimpla stemmator ^a	Ichneumonidae	Hymenoptera
Ec 195	"		Chalcididae	Hymenoptera
Ec 197	"		Ichneumonidae	Hymenoptera
Ec 198	"		Ichneumonidae	Hymenoptera
Ec 188	Pupa	Chalcis euplocae Hope ^b	Chalcididae	Hymenoptera
Ec 189	"		Chalcididae	Hymenoptera
Ec 361	"		Ichneumonidae	Hymenoptera
Ec 190	Larva	Phemius tibialis Westwood.....	Harpactoridae	Hemiptera
Ec 192	"	Proreus simulans Stal.	Chelisochidae	Dermaptera
Ec 191	Larva and pupa	Sphodronyttus erythropterus Burm.	Harpactoridae	Hemiptera
Ec 193	" " "		Formicidae	Hymenoptera
Ec 194	" " "	Carpophilus foveicollis Murr.	Histeridae	Coleoptera

^aDetermined by R. A. Cushman^bDetermined by C. F. Baker

STUDIES ON THE GERMINATION OF VEGETABLE SEEDS¹

GAUDENCIO A. VENTURA

INTRODUCTION

Knowledge of effective methods of germinating vegetable seeds is valuable in truck gardening. Seeds of valuable plants are often lost or spoiled by attempting to germinate them in unsuitable soil or in soil containing an excessive or insufficient amount of water,—conditions which invariably produce poor results.

The present study deals with the germination of some vegetable seeds in soil with different moisture content. Only the two kinds of soil, sand and garden loam, that are most commonly used in germinating vegetable seeds in the Philippines were employed. These soils were compared as to their relative suitability as media for the germination of vegetable seeds. Attempts were made to determine the optimum amount of water that each of these soils should contain to produce not only the highest percentage, but also the most rapid germination of each kind of vegetable seeds studied.

No published account of studies on this subject in the Philippines is available. The Philippine literature on vegetable seeds deals for the most part with the germination of seeds as influenced by chemicals, soaking previous to germination, etherization, etc.,—topics which are not part of the present study. Hence, it was deemed advisable not to include citations from these studies in the present report.

Objects of this study

The present study was conducted with the objects: (a) to determine the relative suitability of garden loam and sand for the germination of vegetable seeds; (b) to determine how much water garden loam or sand should contain in order to produce a rapid and a high percentage of germination, and (c) to determine the rate and percentage of germination of vegetable seeds as influenced by the presence or absence of oxygen in air.

Time and place of this study

This study was carried out in the Department of Plant Physiology of the College of Agriculture, Los Baños, Laguna. The experiments were started some time in April, 1926 and were continued at irregular intervals until May, 1927.

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MATERIALS AND METHODS

The seeds

In the present study nine kinds of vegetable seeds were used.

1. Pechay, *Brassica cernua* (Thumb.) Forbes & Hemsl.
2. Mustard, *Brassica integrifolia* (West) O. E. Schulz.
3. Cabbage, *Brassica oleracea* Linn.
4. Radish, *Raphanus sativus*, Linn.
5. Beet, *Beta vulgaris* Linn.
6. Lettuce, *Lactuca sativa* Linn.
7. Pepper, *Capsicum annum* Linn.
8. Tomato, *Lycopersicum esculentum* Mell.
9. Eggplant, *Solanum melongena* Linn.

The cabbage, pechay, and radish seeds were obtained from the Liu-Paw-Cheng & Co., Manila; the eggplant, tomato, pepper and beet seeds from the Bureau of Agriculture, Manila; the lettuce and mustard seeds from the Agronomy Department of the College of Agriculture, Los Baños.

Only sound seeds of each kind, apparently uniform in size were selected. Seeds that were very small or light, and those bearing signs of injury from the attack of either insects or fungal parasites were discarded.

The soils

Sand and garden loam soil were used for this study. They were taken from the Nursery ground of the College. The sand was brought originally from a river bank in Bay, Laguna.

The garden loam soil was pulverized into fine particles. To obtain particles as uniform in size as possible, the two soils were sieved separately through meshes of about one millimeter in diameter. After sifting, the soils were sterilized at a temperature of 100°C. This precaution was taken so as to be reasonably sure that fungal or micro-organisms that might have been in the soils were killed.

Moisture contents of media

Beakers with a capacity of 400 cc. were used as germination receptacles. The weight of each beaker was determined, then 300 grams of sand were put into each. The weight of each beaker and of the sand it contained together with the weight of the moisture in the sand formed the initial weight of a germinator. Other germination receptacles were likewise prepared. In these receptacles, ordinary garden loam soil was placed. The germinators were grouped into lots of ten. Each lot was treated in such a way that the soil in the first beaker had 100 per cent of water saturation; the second, 90; the third, 80; the fourth, 70; the fifth, 60; the sixth, 50; the seventh, 40; the eighth, 30; the ninth, 20 and the tenth, 10.

In determining the percentage of water saturation of a soil, 300 grams of the soil were put in a glass funnel. Tap water of known amount was

poured into it, catching the excess amount in a beaker. In a saturated condition, the soil was considered to be at 100 per cent saturation. In order to know the exact amount of water present in the soil with 100 per cent saturation, the excess amount of water collected was subtracted from the original amount of water poured into the funnel, the difference was added to the amount of water found in the soil, which amount was previously determined with the use of the usual drying method. The 90 per cent water saturation was obtained by adding to the given quantity of soil, 90 per cent of the amount of water that gave 100 per cent water saturation. The other percentages of saturation down to 10 per cent were determined. This procedure was followed in determining the different degrees of water saturation of each of the two soils (sand and garden loam).

Germinating the seeds

Fifty of the selected seeds were distributed on the surface of the soil in each germinator. Then the seeds were carefully covered with the soil to a depth of about five millimeters. The computed amount of water necessary to make 100 per cent moisture content was poured as evenly as possible on the surface of the soil in germinator 1; 90 per cent into germinator 2; and so on, down to 10 per cent. The moisture content in each germinator was kept constant throughout the period of experiment by adding water daily to replace the loss in weight by evaporation.

The germinators were provided with fairly tight cork stoppers which prevented rapid evaporation of water. There was, however, at the mouth of each beaker a little opening that permitted aëration. The rate of germination was noted every day until no sign of germination was seen. During the experiment the temperature of the air in the laboratory in which this work was conducted ranged from 25° to 34°C.

EXPERIMENTS AND RESULTS

The experiments performed in connection with this study were grouped into three main lots; namely, (1) germination in sand; (2) germination in garden loam soil; and (3) germination as influenced by presence and absence of oxygen in air.

Germination in sand

Seeds of pechay. On May 5, 1926 the first set of experiments on germination of pechay seeds in sand containing different amounts of moisture was started. The number of seeds that germinated in a day; the number of days that elapsed before germination started and the length of time required to obtain a "complete"² germination were observed and recorded. These data are on file in the Department of Plant Physiology in the Col-

²"Complete germination" is used in this paper to mean when no more seeds sprouted.

lege. The data on total germination obtained are recorded as set I, in the upper part of table 1.

Similar experiments were conducted beginning on April 14, 1927. This time, the cultures were run in triplicates; so that three sets of data were obtained. These data are also recorded in table 1 as set II, set III, and set IV.

Seeds of lettuce. The first set of experiments on germination of seeds of lettuce was started on May 19, 1926. In order to obtain data under the same criteria of results employed with pechay seeds, daily observations on the germination of the seeds of lettuce were made. The data thus gathered are not here published but the total percentages of germination are shown as set I, in table 1. These experiments were repeated in three similar sets beginning on April 14, 1927. The results obtained as totals are given also in table 1 as sets II, III, and IV.

Other seeds. With similar methods of germination and of gathering results used with pechay and lettuce seeds, the germination of other seeds were studied. The data obtained for the seeds of tomato, for eggplant, and for beets, are given in table 1.

Germination of seeds of mustard, cabbage, radish, and of pepper was also studied. The germination experiments conducted on each kind of seed were in three sets, (sets I, II and III) and the results, as total percentages of germination of these seeds are shown in table 1.

Germination in garden loam soil

Experiments with this soil were started in a manner similar to that used with sand. The number of seeds that germinated every day in this soil was counted. The number of days that elapsed before the seeds began to germinate and the length of time required in order to have a complete germination were noted and recorded. These data are on file. The total percentage of germination of the seeds of pechay, lettuce, tomato, eggplant and of beets are shown in table 1. Seeds were considered to have germinated when they developed radicles and plumules.

Germination as influenced by presence or absence of oxygen in air

An apparatus consisting of a bell jar connected to a series of bottles containing pyrogallie acid solution on one side, and to an aspirator on the other, was set up. Fifty seeds, of each of pechay, mustard, lettuce, cabbage, beets, radish, tomato, eggplant, and pepper, after soaking them in water, were placed separately on a germinating bed made of moistened cotton. This seed bed was put on a platform and placed under the bell jar. To absorb any oxygen gas that might be present in the jar, two beakers containing a strong solution of pyrogallie acid were placed under the bell jar. This preparation is here designated as the test.

Another apparatus similar to the one just described was set up. In this one, pyrogalllic acid was not used. This preparation served as the control.

The test and the control were placed side by side and were run or started simultaneously. The fine jets of the aspirators, which permitted and regulated the flow of an equal amount of water were opened at the same time. The water from the aspirators flowed through the jets, and a continuous current of air from the outside of the bell jar was sucked or drawn into the system by replacement process. The drawing of atmospheric air into the system was made possible by making the whole apparatus airtight, save the opening through which the air entered. The air that entered the test apparatus was freed of its oxygen by subsequent passage through the series of bottles which contained a strong solution of pyrogalllic acid. Hence, the air that reached the seeds in the bell jar was practically free from oxygen. In the case of the control apparatus, the air that reached the seeds under the bell jar contained oxygen, since the series of bottles through which it passed did not contain any pyrogalllic acid solution. In other words, the test and the control differed in that the germinating seeds in the test was provided with oxygen-free air; while those in the control were supplied with air with the usual amount of oxygen.

For 11 days, the daily rate of germination in each set was noted. The period of observation was of this duration because, according to the results in the early part of this study, it took even less than 11 days for the complete germination of any of the seeds to be attained.

Three trials were made for this study. The data obtained as total percentage of germination of the seeds are shown in table 2.

DISCUSSION OF RESULTS

Rates and percentages of germination

To make the presentation of results clear and concise, the data gathered on the rates and percentages of germination of the vegetable seeds tested will be discussed separately.

Pechay seed. The seeds of pechay began to germinate three days after sowing in sand. In fact, most of the seeds germinated on the third and fourth days. Sprouting, however, continued until the sixth or seventh day, after which time no further germination occurred.

It is shown in table 1 that the seeds of pechay were able to germinate in sand containing from 20 to 100 per cent saturation. The best result, however, was obtained from the pot containing 90 per cent saturation, which gave an average of 93 per cent germination. Sand containing 80 per cent saturation was also found to be quite a satisfactory medium for germination of pechay seeds.

In ordinary garden loam soil, the highest percentage of germination (table 1) was also obtained from the germinator which was supplied with

90 per cent saturation. Eighty per cent saturation was also found to have given a fairly satisfactory result.

Lettuce seeds. The seeds of lettuce germinated in sand with moisture content ranging from 30 to 100 per cent saturation (table 1). From three out of the four sets of tests made, 90 per cent saturation was found to be the best. As the degree of saturation was decreased, there was a corresponding decrease in germination. The converse was also true; for in 100 per cent saturation there was a decrease in the percentage of germination of the seeds sown in three sets of tests or cultures.

As in the case of pechay seeds, the seeds of lettuce began to germinate three days after sowing and highest percentages of germination were obtained three or four days after sowing the seeds. Seven to nine days after sowing, germination of the seeds was found to be complete.

Of the different degrees of saturation tested, the garden loam soil was found most suitable for germination at 90 per cent saturation. As the moisture content was decreased or increased, there was a corresponding decrease in germination. Germination of the seeds of lettuce was found complete eight to nine days after sowing.

Tomato seeds. The seeds of tomato required four to five days to start germinating which was a little longer than either the seeds of pechay or of lettuce needed. Five or six days from the day seeds began to show signs of activity, germination was found to be complete. Under different culture media employed, the highest percentages of germination were obtained six to seven days after sowing the seeds. The highest success in germination was obtained from the sand containing 90 per cent saturation. As the moisture content of the medium was increased or decreased there was a corresponding decrease in percentage of germination of the seeds of tomato. A few seeds were found able to germinate even when the moisture content of the sand was as low as 20 per cent.

In garden loam soil (table 1), the highest percentage of germination of the seeds of tomato was obtained when the soil was supplied with 90 per cent water saturation. With 100 per cent saturation, germination was decidedly low; the 80 per cent saturation proved fairly satisfactory.

Eggplant seeds. In sand, seeds began to germinate about four days after sowing. Nine to ten days later, germination was found complete. Most of the seeds germinated in sand containing different moisture content, five to six days after sowing. The two highest records on germination of the seeds of eggplants were obtained from the media which had 90 and 80 per cent water saturation.

In garden loam soil, the 90 and the 80 per cent saturation were also found to give the two highest percentages of germination and most of the seeds germinated five days after sowing.

Beet seeds. The highest percentage of germination of the beet seeds was obtained when the sand in the pots was with 90 per cent saturation.

This statement is borne out by the results obtained from the four sets of tests. Sand soil with the 100 per cent saturation was likewise very suitable for the germination of beet seed. Although seeds began to sprout five days after sowing, most of them sprouted six to seven days after planting. Seeds continued to germinate daily but at irregular rates and the germination was found to be complete after about eleven days.

In garden loam soil, seeds of beet began to germinate five days after sowing. The process continued up to eight or nine days, though by this time, very few seeds germinated. Beet seeds were found tolerant of rather large amounts of water in the soil. Extremely poor germination of beet seeds was found when the soil had 30 per cent saturation. With 20 per cent saturation or lower no seeds germinated (table 2).

Mustard seeds. Three days after sowing, mustard seeds began to germinate. On the sixth day, only a few seeds germinated, and on the seventh, none. With the 90 per cent saturation, the highest record on germination of this kind of seeds was obtained. As the moisture content of the soil decreased there was a corresponding decrease in the rate of germination. With 100 per cent saturation, germination was found to be fairly satisfactory (table 2).

Cabbage seeds. In sand, cabbage seeds began to germinate three days after sowing, after the fifth day, none germinated. Under the different degrees of water saturation of the soil media, it was found that most of the seeds sprouted three to four days after sowing. The highest percentage of germination undoubtedly was obtained from the soil which had 90 per cent saturation. Germination was decidedly poor when the moisture content in the soil was either increased or decreased (table 2).

Radish seeds. Of all the vegetable seeds tried, radish seeds were the most exacting. They could not germinate unless the sand had at least 40 per cent water saturation. Even with this moisture content only a few seed germinated. The best result on germination was obtained when the soil had 90 per cent saturation. As the moisture content of the pot was increased or decreased there was a corresponding marked decrease in the number of the seeds that germinated (table 2).

Pepper seeds. As with the seeds of radish, the pepper seeds were rather exacting in moisture requirement. They could not germinate unless the sand had at least 40 per cent saturation. And, even with this degree of saturation, only very few seeds germinated. Of the three sets of test cultures tried, the germinator with 90 per cent saturation proved the most efficient in germination. As a whole, the seeds of pepper were rather slow in germinating. Seven to eight days were required to complete germination. There was not a single day in which most of the seeds germinated.

Sand and garden loam soils compared as germinating media for vegetable seeds

In making the comparison on the relative suitability of sand and of garden loam soil as solid media for the germination of the vegetable seeds,

care was taken to compare the data on germination obtained at the same time from these two kinds of soil.

As shown by the germination data for pechay, for lettuce, for tomato, for eggplant, and for best seeds (sets I in table 1 for both sand and garden loam soils), it was sufficiently demonstrated that as a solid medium for germination of these five kinds of vegetable seeds the sand is superior to the garden loam.

By casual observation it was found that more root hairs were produced by the seedlings grown in the sand than by those in the garden loam. This difference probably may be due to the looseness of the particles of sand which encourages the seedlings to produce numerous root hairs which increase the firm anchorage of the seedlings in the soil. It was noted in both the sand and garden loam that as the moisture content decreased the number of root hairs increased. Also, more root hairs were produced in the early than in the later stage of germination, an observation which corroborates the finding of Haberlandt (1914).¹

Oxygen requirements of vegetable seeds during germination

As was expected, the absence of oxygen from the air or the presence of this element in insufficient amount affected germination of most of the vegetable seeds tested. The seeds which were supplied with the ordinary air (air with oxygen) invariably had much higher percentages of germination than those that were subjected to the influence of oxygen free air, (table 2). Oxygen, therefore, is essential for the normal germination of all the vegetable seeds tested. In passing, it may be said that the seedlings under the direct influence of ordinary atmospheric air generally had longer and larger stems than those of the seedlings grown in the presence of air supposedly oxygen. These seedlings looked sickly. In fact, the tops of the beet seedlings curled and dried up.

SUMMARY AND CONCLUSIONS

1. In both the sand and the garden loam soil, the seeds of pechay, lettuce, cabbage, and mustard began to germinate on the third day after sowing; those of pepper, radish, and eggplant on the fourth day and those of tomato and beets on the fifth day.

2. The highest percentages of germination of the seeds of pechay, lettuce, cabbage, radish, pepper, eggplant, and tomato, were obtained from sand with 80 to 90 per cent water saturation; 90 to 100 per cent saturation was found the most suitable for beets and mustard seeds.

3. Garden loam soil with 80 to 90 per cent saturation was found to be best suited for the germination of seeds of pechay, lettuce, tomato, and

¹Haberlandt, C. 1914. *Physiological plant anatomy*. xv+777 p., 291 fig. London: The Macmillan Company, Ltd.

eggplant. For beet seeds the best results were obtained with 90 to 100 per cent saturation.

4. A few seeds of pechay were able to germinate in sand with as low as 10 per cent water saturation. Some seeds of tomato, eggplant, mustard, and cabbage germinated with saturation as low as 20 per cent. Seeds of lettuce and beets were sensitive; some were able to germinate in sand only when water saturation was at least 30 per cent. Seeds of radish and pepper were still more sensitive; few were able to germinate in sand with as low as 40 per cent saturation.

5. Sand soil was found to be a better solid medium for germination of all the vegetable seeds studied than garden loam soil.

6. Invariably, the germination of any of the vegetable seeds studied was markedly checked, and the young plants were markedly stunted in growth, when supplied with air without oxygen or with oxygen in insufficient amounts.

Percenta

KIND OF SEED	Set	
		100
Pechay....	I	74
	II	84
	III	80
	IV	82
	Average	80
Lettuce....	I	40
	II	68
	III	70
	IV	56
	Average	59
Tomato...	I	50
	II	58
	III	42
	IV	46
	Average	49
Eggplant..	I	80
	II	76
	III	70
	IV	68
	Average	74
Beets.....	I	60
	II	68
	III	66
	IV	60
	Average	64

TABLE 2

Percentage germination of vegetable seeds as influenced by ordinary air and by oxygen-free air

SET	PECHAY		MUSTARD		LETTUCE	
	Ordinary air	Oxygen-free air	Ordinary air	Oxygen-free air	Ordinary air	Oxygen-free air
I	76	28	78	22	78	18
II	74	24	70	16	50	22
III	66	14	36	14	40	6
Average.	72	22	61	17	56	15

	CABBAGE		RADISH		BEETS	
	Ordinary air	Oxygen-free air	Ordinary air	Oxygen-free air	Ordinary air	Oxygen-free air
I	70	30	44	16	72	32
II	60	10	40	12	72	26
III	60	16	36	10	68	36
Average.	63	18	40	13	71	31

	TOMATO		PEPPER		EGGPLANT	
	Ordinary air	Oxygen-free air	Ordinary air	Oxygen-free air	Ordinary air	Oxygen-free air
I	48	12	30	14	32	10
II	46	4	30	8	32	8
III	54	10	26	12	20	2
Average.	49	9	29	11	28	7

NOTE: THE ECLIPSE OF MAY 9, 1929

The Manila correspondent of the *New York Sun* writes that a total eclipse of the sun will occur there on May 9, 1929, and the Hamburg Observatory has already arranged to have an observing party in the Philippines on that date. It is expected in Manila that other parties will come from the United States and Europe.

Full information was forwarded by Father Miguel Selga, S. J., director of the Philippine Weather Bureau and the Manila Observatory, to the astronomers' meeting in Leyden. Two factors warrant the expense of sending parties, Father Selga says, first, the great probability of clear weather, and second, the duration of the total eclipse over accessible and convenient observation points.

The plane of total eclipse extends across the middle islands of the Philippines, the Visayan group, through the tenth and two-thirds of the eleventh degrees of north latitude. On the western coast the duration of the total eclipse over this area will be 3 minutes 54.5 seconds; this in the vicinity of Dumarán Island, Palawan. On the eastern coast at good vantage points the duration will range between 3 minutes 42.3 seconds to 3 minutes 28.7 seconds. The longest duration of any eclipse is only about 7 minutes and such eclipses are infrequent, even speaking astronomically. There will be places outside the Philippines, in Sumatra and Siam, for example, where the eclipse may also be observed, and while Father Selga is little familiar with the accommodations that may be found there, he thinks some of the foreign parties may choose those points. He believes, however, that all American parties should choose the Philippines, to which end he has prepared the bulletin of information on living accommodations, sites, etc., appended to his scientific data.

He says that under no circumstances should astronomers be discouraged from trying to see the eclipse of May 9, 1929, in the Philippines. He has traced back the weather on May 9 at four convenient observation points during a period of twenty-five years and finds that the chances are very great that May 9 next year will be dry and clear. The date is prior to the change of the monsoon, and, while at that season of the year there are nearly always some clouds floating about during the day, at the afternoon hour of the eclipse the sky is almost certain to be clear. He selects eastern coast points, fronting the open sea. If there are clouds they will be hovering around the mountains to the west.

—*Science.*

ABSTRACT¹

The relation of rainfall to the production of corn. SIMPLICIO TIGLAO. (*Thesis presented for graduation, 1928, from the College of Agriculture No. 277. Experiment Station contribution No. 565*).—The object of this work was to find out the relation of rainfall to corn production. This study was carried on from May 27, 1926 to April 11, 1927. Experimental plots of about 50 by 26 meters, located in the Experiment Station grounds of the College of Agriculture, were used. The lots were well suited to growing corn. Their preparation was uniform. Depth of planting, number of seeds in a hill (three), and distance between hills (one meter) were uniform in all plantings. After four weeks, each hill was thinned to two plants. When harvest was ready the ears in 100 hills picked at random were gathered, dried properly, and weighed. The plants at the edges of the plots were eliminated.

The record on rainfall was taken from the College data.

The results of this study show that there was better yield in the May and June plantings of Calauan and Baluga varieties than the yield of the same varieties in December. This was so because there was optimum amount of rain at the different stages of the plants of the May and June plantings, while there was a scarcity of rain during the vegetative and fruiting stages of the December planting. This shows the importance of effect of the distribution of rainfall.

In the Moro variety there were three plantings. The June planting gave the best yield, the July planting second, and the August planting the least. The first four weeks after the June planting there were 68.4 mm. of rainfall; the first four weeks of the July and August plantings were rainy. The rainfall in June was a good condition for growth, while that of July and August caused the rotting of the seeds and stunted the development of the seedlings. This shows that too much rain at the time of germination reduced the yield because there were missing hills and stunted development of the young plants.

—Abstract by Severino L. Salvado.

¹ Abstract prepared as part of required theme work in English 6, College of Agriculture.

EXTENSION DIVISION NOTES

(Reported by Mr. Moises M. Kalaw, Assistant in Extension Service.)

An Hacienda Worth Visiting

An hacienda in the Visayan Islands, which I visited I found very well worth seeing. This is Mr. Teofilo Mejia's hacienda at Puerto Bello, Ormoc, Leyte. It should be visited by those interested in Philippine agriculture. In this hacienda one can see what a paradise a Philippine farm can be made, if managed and developed properly. There are many fine haciendas in other provinces of the islands as in Negros, Iloilo, but the Mejia Hacienda is something quite different. Unlike other large haciendas which are mostly one-crop farms, the Mejia Hacienda is diversified, a type fitted to Philippine conditions. Besides the main crops which are corn, coconut, sugar cane, and abaca, there is a ranch, a pig project (with a pig pen very similar in plan to the one in our Animal Husbandry Department), a poultry project and a pigeon house. With such diversification the people living there buy nothing from the outside except clothing and a few luxuries. All the projects in that hacienda are well developed and managed, as if one well versed in the science of agriculture was at the head.

One can learn many things in this hacienda. It has a complete drainage system worth copying. The plan of the hacienda itself is exemplary. There is much to be learned from the coconut plantings and the hog projects. The coconut plantation is the cleanest private plantation I have ever seen. It is almost comparable in cleanliness to the Government plantation at San Ramon Penal Colony at Zamboanga, Mindanao.

It is the practice of the senior class of the Baybay Agricultural school to visit the Mejia Hacienda once a year. For instruction and observation it is well worth visiting by any one interested in agriculture. Students from the College of Agriculture who live near Leyte should try to visit this hacienda. It is a barrio about an hour by launch from Ormoc, a large town in Leyte.

Drying Problems in Leyte

While supervising the construction of a New College Copra Drier in Leyte, I had the chance to get first hand information regarding some of the farmer's problems from hacenderos who visited the drier. I learned that one of the agricultural problems in Leyte is the drying of coconut, corn, and rice early enough to prevent deterioration which causes heavy losses.

Farmers want drying devices. They were planning to use the New College Copra Drier with modification not only for copra but also for rice or corn. It may be possible to do this. The New College Copra Drier has

been tried for peanuts in Lipa, but it did not work, but it might if modified. A simple and cheap drier for drying rice or corn would be invaluable to Leyte farmers.

EXCHANGE NOTES

Democracy is an affair of the biologists and not the political scientists. This is the conclusion reached by Dr. Michael F. Guyer, head of the zoölogy department at the University of Wisconsin. For a democracy to survive, it must be carried on by a race having certain qualities of disposition, character and intellect. Because these things are inherited just as a man inherits physical characteristics, such as color of skin, hair and eyes, Dr. Guyer contends, the development of a race having the qualities necessary to operate a democracy successfully rests with the biologists.

—*Science*.

The cooperative movement in India is making comparatively rapid progress despite the many handicaps to be overcome, according to a statement issued by the department of commercial intelligence and statistics. At the end of 1926-27 the report shows that there were in India 89,071 societies with a membership of 3,422,000, and a total capital of 679,400,000 rupees.

—*Commerce Reports (U.S.)*.

Much damage is caused to the rice crop in North Sind [India] by the formation of a thick layer of algae upon the water surface, if for any reason the water remains stagnant, as for example, where there is no natural fall in the level from field to field or again in low-lying places. It is comparatively rarely found where the water circulates freely from the higher field to the lower. Rain is also a preventive. This scum begins to develop soon after transplantation and in bad cases it increases until there is a thick green carpet resting upon the water surface, pierced only by the rice clumps. Gradually this scum tightens its grip round these clumps which becomes partially strangled and tillering is prevented.

The following treatment worked out on the Larkana Experimental Station has given excellent results. About 16 to 20 lb. (worth Rs. 12-8-0) of copper sulphate crystals per acre should be put in a cloth bag which is drawn through the field under the water surface so as to ensure uniform distribution.

Less quantities of copper sulphate will do if only a part of the field is covered by scum.

The scum dries up and settles leaving a clear water surface three to five days after the application of the treatment and *does not* reappear with subsequent irrigations.

—*The Agricultural Journal of India*.

The New England States have developed strains of the flint corns that give both yield and quality. They are beautiful ears. Most of their strains are of a bright amber color. The cob is usually white. When the corn is shelled it has a bright, attractive color. When cracked for chicken feed or when ground for meal, it is also attractive. Those who have used it for mush and for bread love it. It is so very hard that it needs to be cooked longer than does the softer dent corns. It has a small germ, and therefore, it yields but little oil as nearly all of the oil found in corn is contained within the germ. Those who grow accustomed to the western dent or corn belt type of corn, develop a distinct prejudice in favor of the dent corn, because of flavor that comes from the oil content, whereas, the up-state New Yorkers are equally favorable to their Yankee types of corn.

There is a great deal of interesting history attached to these different kinds of corn. The Indian developed the hard flint type mainly because he could adapt its habit of growth to suit his kind of farming. He had almost no implements or other farming equipment. He fashioned a sharp stick which the squaws used for planting corn. The sharp stick would open a hole four or five inches deep. The kernel was dropped into the hole deep enough to have moisture to carry it through a drouth period. It was deep enough to be out of reach of crows that seemed to have an uncanny sense of smell in locating planted kernels. They were known to rob a newly planted field, where shallow planting was practiced, and leave not enough kernels to grow. The Indians tried smelly fish oils for soaking the kernels, as a repellent for the crows. This was only partially successful. The deep planting caused the corn to develop a long cotyledon, which is the extension from the kernel to the new growth that gave the first pair of leaves. Some of these Indian developed types grow when planted as much as six inches deep.

—*California Cultivator.*

The task of studying the farm production of a state in relation to market demands and farm management practices properly belongs to the agricultural college. Some of our agricultural colleges are aggressive in meeting new conditions in agriculture. Others are less so. Farmers naturally look to their agricultural college for leadership, and this the college should be prepared to furnish. The policy of letting things drift in the hope that they may eventually right themselves is not a good one for an agricultural college to adopt.

—*The Prairie Farmer* (Illinois).

Three square chains of Uba and three square chains of ordinary cane were planted on the same kind of land and grown under same conditions in Jamaica.

The Uba cane when cut and ground yielded 31 pork barrels of liquor which gave 29 tins of sugar.

The ordinary cane yielded 15 barrels of liquor which gave 15 tins of sugar. The Uba sugar was slightly darker but both kinds sold in March for 8/ per tin.

Uba cane gave larger tonnage per acre, does not require so much cleaning as the ordinary cane, and is immune from Mosaic disease; rats leave it almost entirely alone and the native carriers do not eat it, or only very sparingly.

—*The Journal of the Jamaica Agricultural Society.*

COLLEGE AND ALUMNI NOTES

Dr. Regino R. Ylanan, National Secretary, Philippine Amateur Athletic Federation, and Alumni representative on the Board of Regents of the University of the Philippines, spoke at the students' convocation at the College of Agriculture Auditorium, October 31, 1928. The theme of Regent Ylanan's talk was the World's Olympiad at Amsterdam, Holland. He gave a vivid description of the classical event, and the representation the Philippines made.

A one hour lecture on algae, liverworts, mosses, and ferns was given by Dr. R. B. Espino to the class in biology of the Rizal High school that came to visit the College on October 27, 1928.

Dr. R. B. Espino gave a semi-popular lecture on "How A Plant Lives" to the members of the biology class of the Cavite High School in the College Auditorium on November 3, 1928.

Dr. C. E. Pemberton, the entomological member of the expedition sent last spring by the United States Department of Agriculture and the Hawaiian Sugar Planters Association to explore New Guinea for new varieties of sugar cane, in a letter to Professor Yule written from Port Moresby, New Guinea under date September 10 sums up the work thus:

I left Honolulu April 18th bound for New Guinea and have been here ever since and expect to stay perhaps a year longer.

Since arriving I have flown thousands of miles in a sea-plane we have for our expedition; have traveled by canoe hundreds of miles on the rivers, particularly the Fly River and have walked some 150 miles back in the mountains. We have collected considerably over 150 new varieties of sugar cane, some of which will very probably prove of great commercial value. . .

The expedition is now over without a mishap (malaria doesn't count). The party leaves here for U. S. A. in a few days. I will stay here to continue researches in insect parasitism.

Doctor Pemberton spent a year, 1925-26, on our Campus in research work for the Hawaiian Sugar Planters Association, using Mount Maquiling as a "source".

In his letter, Doctor Pemberton inclosed (unsolicited) a generous contribution for the Baker Memorial Fund.

Mr. Jose M. Capinpin, M. S. '23, who sailed in August for the United States, as U. P. Fellow, writes that he has registered in the Graduate School in Princeton University.

The luggage of the faculty and students now tells the world its owners are from the College of Agriculture. Attractive "stickers" are now on sale at Coop. These "stickers" are pennant shaped; green with "Agriculture" in gold (College colors); on the wide end is the U. P. seal in poinsetta red, ("U" color). These stickers are the result of Mr. Zosemo Montemayor's initiative.

A RESEARCH DELUSION¹

..... Interest is centered in output rather than in quality. This is just another characteristic symptom of megalomania, so prevalent in our day in most lines of endeavor. . . I think that on an occasion of this kind a brief period can be profitably spent in analyzing the present tendency in research in order that we may have a better understanding of what actually constitutes research.

Research consists of more than the mere accumulation and publication of facts. Research in its highest aspect is something creative, akin to the well-known masterpieces of art, music and literature. A masterpiece is the product of the artist's mind, in that any one using the same oils and paints could not create a similar picture. The same creative urge is shown in music and literature. It is true that the scientist can not create any new material thing, but neither does the painter use anything in the way of materials other than those available to any one. However, the master scientist can so arrange his materials and facts that they represent a fundamental contribution to science as a painting does in art. As in art a masterpiece may go unnoticed for years, so in science the true value and significance of a contribution may escape attention for decades, but once its proper value is ascertained it persists for ages.

It is rather disconcerting to listen to classical music and to realize suddenly that the melody transposed and in quickened tempo forms the basis of the latest jazz hit. The same feeling comes over one after reading an article to find that, although some new data are added, it is just a transposed rendition of some old familiar contribution. As in the arts, music and literature there are too many imitative and not enough creative minds. It is impossible for us all to become creative scientists, but we should at least strive towards this goal.

The English cleric who recently suggested that all active research be abandoned, for a period of ten years, had in mind, I think, that too much work was being repeated and the period of inactivity would bring us to a realization of the futility of doing research without an adequate understanding of what has previously been accomplished. An analysis by a master in his field of all existing data in his specialty would advance research much faster than the addition of more data during this period. As a merchant takes stock once a year and balances his accounts to see what progress has

¹ Address of the past president of the Nebraska Academy of Science, Fremont, Nebraska, April 27, 1928.

been made, so should we take stock at intervals of all the endeavors in our special field of science. A carefully digested inventory of the investigations in our field can not but lead to research of a higher standard. Not only do we fail to digest properly the publications of previous workers, but we are so intent on the mere collection of data that we do not take the time to weigh our data in their broad relationships.

It is true that from an economic standpoint the collection of new facts has yielded large returns, but soon, unless some precautions are inaugurated, having been so thoroughly sold on the benefits of scientific endeavors, the public will expect the impossible. Have the contributions of science to the progress and development of civilization made us a better and more cultured people? Scientific discoveries have no doubt given us more leisure than the world has ever known before. Are we producing any great works of art, music or literature in our times as the result of this leisure?

Perhaps at this point it might be well to review the history of science and attempt to determine how fundamental discoveries were brought to fruition. It is well known how the philosophical theories of Aristotle permeated the thought of Europe for centuries. While many of Aristotle's observations are sound, his deductive reasoning on natural phenomena probably more than any other factor held in abeyance the adoption of the experimental or inductive methods in science. Galileo, on the other hand, after much thought propounded his theory of falling bodies and was able to prove experimentally that his deductions were correct. The discoveries of Newton, Faraday and others are very striking in that they propounded fundamental laws on what would now be considered very meager data. I am inclined to believe that their profound knowledge of mathematics was a great aid in arriving at the conclusions they did with so little data. Darwin, however, went to the opposite extreme and amassed a large amount of data over a long period of years before he announced his theory of the origin of species. One could cite numerous examples of the thought that was given to the interpretation of data before it was offered for publication.

The present tendency is to accumulate a super-abundance of facts and data and devote too little time and effort in the proper correlation and interpretation of them. It is high time that we do relatively more thinking and less investigating if we are to maintain the high standards which have been set up for us by the past masters of science.

How are we to attain the goal of creative research? This question can not be answered any more easily than one can explain the production of a masterpiece in art, music or literature. However, it is possible to discuss some of the avenues which might lead to creative research. I am sure that when we began our careers in the sciences we were prompted to do so either through curiosity, humanitarianism, personal vanity, imitation or some such motive. Whatever this urge might have been originally, without it I doubt if any of us would spend the energy we do in research.

In more ways than one this incentive is like a mirage, always in the distance, but for some reason or other we are never quite able to catch up with it. This failure to catch and hold a creative thought is partly due to the fact that we are not real dreamers or good philosophers. We are so busy collecting facts that we fail to give them much thought. Have you ever analyzed where your ideas originate? You will frequently find that it is during moments of relaxation, when the problems demanding your working energy are farthest from your thoughts. It is seldom that the most constructive thinking is done while busily engaged in the laboratory. More relaxation and reflection would be much more advantageous in solving problems than the mere collection of more data. With relaxation and reflection our subconscious mind might function and flash to us in an instant the clues which we were vainly groping for while in the laboratory.

Even if we ourselves fail to do creative research we can stimulate the rising generation of scientists to hunger for the goal and in this fashion make our contribution to the advancement of science. It should be the chief aim of the teacher in his contact with students to direct and stimulate them to thinking, rather than to fill their minds with masses of unrelated facts, which are always available, providing they have been taught where to find them. Convenient and accessible libraries should be built up, even at the expense of the laboratory, and students taught to use books constantly, as they would indispensable methods in the laboratory. Our graduate students for the most part have access to too much work and thought evading equipment. It is really surprising what can be done in the way of substantial research without costly apparatus. It is only necessary to refer back to the old masters of science to substantiate this statement.

Let us therefore stop deluding ourselves. The aim of research is not solely the accumulation of facts for immediate publication so that we may in vainglory point to our output for the year. We must strive to do more constructive thinking and especially give our minds an opportunity to function through proper relaxation. We shall not advance fundamental science if we are simply busy collecting data. With more constructive thinking on our problems there would be fewer but better publications, an era without doubt we should all sincerely welcome.—GEORGE L. PELTIER, UNIVERSITY OF NEBRASKA

—*Science*.

... There are few men living who have a greater capacity for work and who are more tireless in their work than Charles F. Baker. He is a man who sees big visions and who, instead of dreaming, sets about with joyful zeal and a bulldog determination to make these visions realities. As a friend, one can want no better. As an enemy, one never is in doubt as to his opinions and sentiments. He is open-hearted and large-hearted. One feels a strong stimulus to a better and a larger life when he comes into contact with this man.—DAVID L. CRAWFORD, *Professor of Botany*.

—(*From Pomona College Journal of Economic Botany III: Dec., 1914*).

Dean—of Harvard has proposed a “battle of culture” to take place between student teams of ten men each from Yale and Harvard. Under the plan the teams would take identical examinations which would cover all departments of study. The object of the competition is to stimulate interest in studies to offset the emphasis now placed on athletics.

—*What The Colleges Are Doing*.

I like trees
Which do not fear to stand
All alone against the sky,
With space on either hand.

And I like the folk
Who need not herd together,
It takes the strongest trees and men
Alone to face the weather.

—HILDA MORRIS in *Rural New Yorker*.

—*The Aberdeen-Angus Journal*.

The creative scholarship of the teacher is what makes “higher education” higher than other education. It behooves universities to foster and conserve it, as it behooves students to appreciate it.

—*Harvard Alumni Bulletin*.

A man there was, at least he *looked* like man;
His hair was smooth, his coat, spick and span.
And yet in the place God made for a mind,
There was nothing at all! Fine fruit—but all rind!

—C. F. BAKER.

THE TREND OF SEXUAL AND REPRODUCTIVE SEASONS AMONG HORSES, CATTLE, WATER BUFFALOES, SHEEP AND GOATS UNDER LOS BAÑOS CONDITIONS: A PRELIMINARY REPORT¹

VALENTE VILLEGAS

Of the Department of Animal Husbandry

WITH TWO CHARTS

The animal breeder desires to know any tendency there may be in the seasonal activities of breeding animals under his care. A knowledge of the trend of females to come in heat and become fertilized during certain periods of the year would lead to a more rational preparation and distribution of the males during such seasons and a consequent higher reproductive efficiency of the females. Also, information concerning the production of a greater number of young during certain months of the year is advantageous as the breeder can provide adequate facilities so as to reduce the mortality to the minimum when reproduction occurs during unfavorable months of the year.

REVIEW OF LITERATURE

Gay (1923) states that the spring season is the natural time for foals to arrive but mares may be bred to foal during the fall.

According to Mumford (1920) the sexual functions of horses and cattle are more active in the spring. In the case of the mutton and merino sheep, the sexual activity is more prominent in the fall. The Dorset Horned breed of sheep may breed any time of the year.

Marshall (1922) points out that mares are polyoestrous, the sexual season occurring in spring and early summer, being the longest with more domesticated breeds. Citations are made by the same author that wild cattle show a restricted sexual season, while domesticated individuals breed any season of the year. With sheep some wild species are monoestrous while certain more domesticated breeds are polyoestrous. Reference is made to the hill sheep of Great Britain which usually breed from about the middle of November until the end of the year; in the other breeds the sexual season is earlier. The British sheep breed only once a year with the exception of the Limestone sheep of Westmoreland and Derbyshire and the Dorset Horn Sheep of the south of England which breed more than once a year. Certain Australian Merinos are claimed to exhibit sexual activity all the year round. With regard to the Indian sheep, there is no definite season

¹Experiment Station contribution No. 579. Read before the Los Baños Biological Club on November 22, 1928. Received for publication November 26, 1928.

for lambing. Wild goats behave in a similar manner, according to Marshall, that is, their sexual season is restricted. Citing Low, in the case of domesticated goats, oestrus takes place at very frequent intervals.

Asdell (1926), studying the "Kid Register" of the British Goat Society, found that the maximum reproduction takes place in October and the minimum in May.

From a study of various breeding establishments of draft horses in the United States, Villegas (1923) found that many of the farms have an open breeding season from March till July, while a few of the establishments accept mares for breeding any month of the year.

OBJECT

The object of this report is to set forth observations on the trend of sexual and reproductive seasons among horses, cattle, water buffaloes, sheep and goats under Los Baños conditions.

TIME AND PLACE

The data presented are based mainly on the reproductive records of animals of the Department of Animal Husbandry with the exception of a few mating records of horses and goats.

Based on the reproductive records of the different classes of animals observed in this department the periods covered by this study are:

CLASS OF ANIMALS	INITIAL DATE OF REPRODUCTION	LAST DATE OF REPRODUCTION	PERIOD
Horses.....	Nov. 20, 1920	July 31, 1928	7 yrs., 8 mos., 11 da.
Cattle.....	April 22, 1920	July 7, 1928	8 yrs., 2 mos., 15 da.
Water buffaloes....	Jan. 15, 1917	July 18, 1928	11 yrs., 6 mos., 3 da.
Sheep.....	Sept. 14, 1923	March 12, 1928	4 yrs., 5 mos., 27 da.
Goats.....	Jan. 18, 1923	April 14, 1928	5 yrs., 2 mos., 27 da.

ANIMALS

The greater number of the mares used in this investigation were of native breeding, a few of them being grades with Arabian blood. With cattle, the majority were natives and grades; there was a small number of pure individuals of the Nellore and Hereford breeds. The water buffaloes were mostly native carabaos with a small number of Indian buffalo breed and grades. The sheep were largely of Indian blood. In the case of goats, practically all of the animals were Indian and Nubian grades.

Few of the females studied were very old, most of them being very young or medium in age for breeding purposes.

MANAGEMENT

Horses belonging to the College of Agriculture were observed for oestrus and subsequently bred to the stallion. A general procedure was followed

with regularly breeding mares; they were bred at foal's heat, or nine days after foaling; in almost all cases the mares willingly received the male. With outside mares most of them were bred at random by stallions which by chance came in contact with the mares at the period of heat.

With cattle, water buffaloes and sheep, breeding took place in the pastures. At all times the requisite number of males was placed with the females to insure the breeding of all females that were in heat.

For a time the breeding of does was carried out by allowing the buck to go with the herd at all times. Later, when the condition of the male was observed to run down the system was changed. The buck was mixed with open does for a brief period each morning so that any of them that might be in oestrus were bred at that time. The buck was then returned to his pen where individual care and feeding was given to him. With this treatment the buck is expected to increase in breeding efficiency and longevity.

DISCUSSION OF RESULTS

The basic data from which the matings of each class of animals were computed consist mostly of the records of reproduction of the females. As has been mentioned, a few records of matings among horses and goats were directly used. Such records include data giving only one definite mating with a corresponding reproductive event for each female.

Where no matings are known, these were obtained by counting back the number of days corresponding to the average normal period of gestation of each class of animals from the dates of reproduction. For horses a period of 340 days was used; for cattle, 280 days; for water buffaloes, 324 days; and for sheep and goats, 150 days.

It, therefore, follows that the dates of matings here presented cover only successful services.

It is understood that the animals included in this study may be bred any time of the year when their period of oestrus comes. It seems, however, that with classes of animals showing a preponderance of sexual activities during certain seasons of the year, they strongly evince their desire for mating in those seasons and become more readily impregnated.

As previously stated, the reproductive records presented here are actual data pertaining to each female, from which the major part of mating records were obtained. It is evident, however, that the reproductive activities of the animals are determined by the season of successful matings among them.

The primary aim in presenting the reproductive incidence of the animals, is therefore, to present any definite behavior there may be in the reproductive season of each class of animals with a view of providing the necessary care for the young born during unfavorable months of the year.

Horses

As may be seen in table 1, there were 53 matings with mares, of which the greatest number occurred in March and April, constituting for the two months a total of 50 per cent of all the services during the year. The mares were also successfully bred in other months of the year but to a much lesser extent. For a more concise comparison of the percentages for each month see chart 1.

Despite the relatively small number of cases on which the results are based, it is apparent that the most suitable season to have mares bred is during the dry and hot months of March and April.

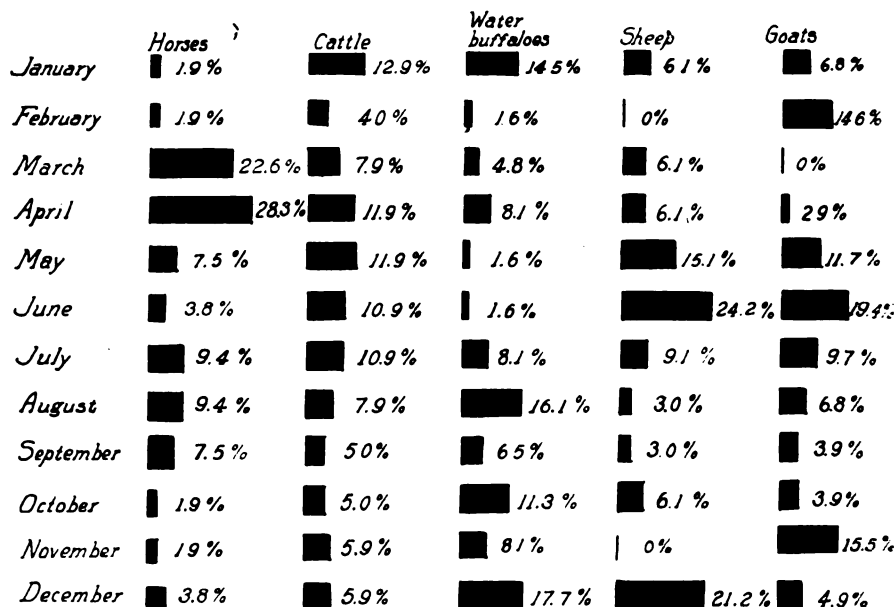


Chart 1.—Showing the monthly distribution of successful matings among horses, cattle, water buffaloes, sheep and goats.

As may be seen in table 1 and chart 1, out of the 53 foalings, 36.5 per cent fall during March. For the two months of February and March, the reproductive incidence amounts to almost one-half of the total, or 48 per cent. In April the percentage was 7.7, so that during the three months from February to April over half of the reproductive incidence took place, or 55.7 per cent. It is, therefore, evident that, even with only 53 foalings as a basis, the trend of the reproductive season is sufficiently marked that it may be said to center during the beginning of the dry season.

Cattle

Table 1 shows a total of 101 matings among cattle included in this study. From this table and in chart 1, it does not seem that cattle have the

tendency to breed in any given season of the year. The higher percentages shown from March to August over the rest of the months, except January, are not marked enough to indicate that such months constitute a more favorable sexual period for cattle. Less importance may be given to such months considering that the highest percentage during the year occurs in January, preceded and followed by lower percentages for December and February. The different percentages of sexual activities distributed for the months of the year may, therefore, be taken as the result of natural variations in the breeding behavior of cattle. Hence, it may be assumed that cattle mate any time of the year.

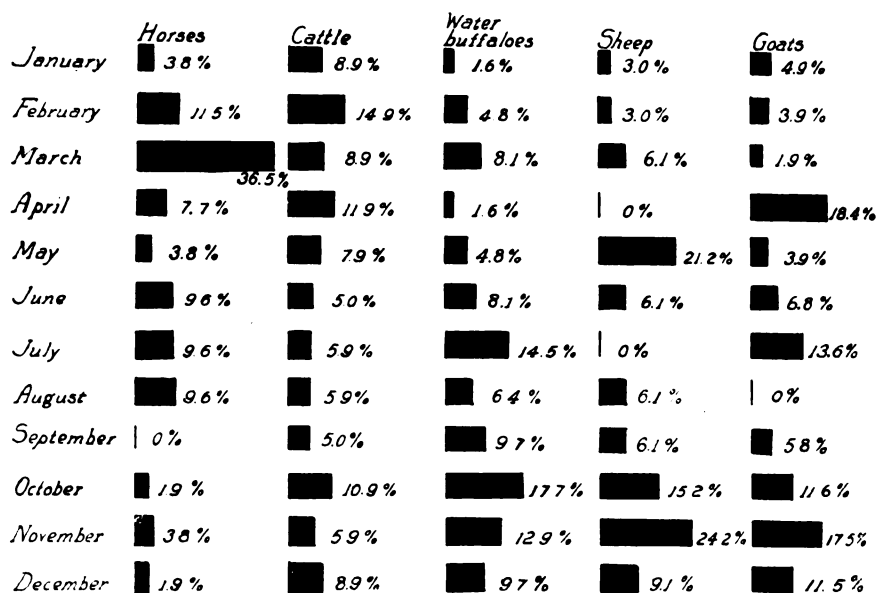


Chart 2.—Showing the monthly distribution of reproductive incidence among horses, cattle, water buffaloes, sheep, and goats.

Table 2 and chart 2 show that no marked season was followed in the reproductive period of cattle. The total number of calvings covered by the study was 103, of which the lowest percentage was 5, occurring in June and September, and the highest percentage 14.9, occurring in February. The variations in the calvings for the different months do not show any marked tendency to indicate the period of the year when these animals would naturally calve following successful breeding activities, although to a certain degree, chart 2 shows that during the early and later parts of the year the percentages are relatively higher than during the middle which are the wet months.

If this is true, it would be a fortunate coincidence because there will likely be fewer losses when calving occurs during the drier period of the year.

Water buffaloes

Sixty-two successful matings are shown in table 1 with water buffaloes. Looking over chart 1, it appears that the preponderance of sexual activities fall from August till January, or during the cooler and wet months of the year. However, on account of the relatively small number of matings upon which the results are obtained it does not seem justifiable to make conclusions. A greater number of cases should first be noted.

According to table 2 and chart 2, the greater calving season among water buffaloes is during the second half of the year. From July till December over 70 per cent of the calvings took place. There are, however, only 62 calvings upon which this study is based; additional data are awaited to make conclusions on the reproductive behavior more reliable.

If water buffaloes naturally calve during the wet and cooler months of the year, while weather and feed conditions at this time may be most favorable for the rapid development of the young, still under an intensive system of management breeders would do well to provide for calves clean pastures and night corrals as a protection from intestinal parasitic infestation. The highest mortality among water buffalo calves caused by parasites at the College of Agriculture is during the rainy months.

Sheep

Table 1 includes 33 matings with sheep. Even with this low figure as a basis, it is apparent on chart 1, that the greatest sexual activity among sheep takes place in May and June, during which time 39.3 per cent of the matings took place, and in December, when 21.2 per cent occurred. The two periods shown indicate the behavior of grade Indian sheep as breeding twice a year, unlike most breeds of sheep which breed only during the latter part of the year.

As may be seen in table 2 and chart 2, out of 33 lambings recorded with sheep, 21.2 per cent occurred in May. This was followed by the second lambing season which was in October and November, giving a total 39.4 per cent. For a more definite conclusion, however, more data are necessary.

Goats

Table 1 shows that with goats 103 matings are included in this study. Like sheep, goats exhibit two sexual seasons during the year. As may be seen in chart 1, it is evident that during May and June sexual activity is heavy, or a total of 31.1 per cent; the second period falls in November, with 15.5 per cent, probably covering the period until February, during which month the percentage is 14.6. The low figures for December and January are expected to show more favorably, later, as mating records increase.

There are also two marked kidding seasons with does, as shown in table 2 and chart 2. Out of 103 kiddings, the highest percentage 18.4

occurs in April. From April to July probably constitutes the first period, with a total of 42.7 per cent followed by the second period from October till December, with a total of 40.6 per cent. The fact that August does not show any kidding deserves mention, considering that there are more than 100 cases treated in this study.

Undoubtedly with goats as with sheep, there exists two marked reproductive seasons in the year. The first season starting in April produced kids facing a rather unfavorable climatic condition during the rainy months of the year. In the second season which begins in October, when it is wet and cool, the kids, if properly taken care of while young, may fare better than those born the previous season, because of the drier months which follow October. This dry season is the time of the year during which goats of all ages thrive best.

SUMMARY

From the foregoing observations the following salient points may be noted:

1. Sufficient data are presented to indicate definitely the sexual and reproductive behavior of cattle and goats.

2. While the records available for horses and sheep are not large, the percentages show markedly the trend of the sexual and reproductive seasons of these animals.

3. More data are necessary to indicate the real trend of the sexual and reproductive seasons among water buffaloes.

4. The sexual season with horses takes place during the months of March and April. The foaling season occurs in March.

5. With cattle the sexual and reproductive seasons do not follow any decided trend. An appreciable number of matings and calving incidents take place any time of the year.

6. It is apparent that with water buffaloes the trend of both the sexual and reproductive seasons appears to be heavier during the second half of the year.

7. Sheep breed mostly in May and June and again in December. The lambing time takes place heavily in May and even more abundantly in October and November.

8. Goats follow practically the same sexual and reproductive seasons as sheep. May and June recorded high in sexual activities, the next season occurring from November till February. The kidding season starts in April and covers a period of four months or until July; it begins again in October and ends in December.

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THE TREN

buffaloes, sheep, and goats

AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
number	per cent	number	per cent	number	per cent	number	per cent	number	per cent
5	9.4	4	7.5	1	1.9	1	1.9	2	3.8
8	7.9	5	5	5	5	6	5.9	6	5.9
4	5.4	5	6.9	3	4.1	4	5.5	4	5.5
2	11.8	0	0	2	11.8	1	5.9	0	0
2	18.2	0	0	0	0	1	9.1	2	18.2

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COMPARATIVE WEAR OF CERTAIN METALS AND ALLOYS USED IN PLOWS AND DISK HARROWS¹

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Of the Department of Agronomy

FIVE TEXT FIGURES

Of all tillage implements the plow and harrow are probably in most common use for crop production. Their importance is so great that investigators have spent much time in trying to attain a satisfactory design to meet varying field conditions. These two implements have been studied so intensively by plow and harrow designers that there are many models on the market.

The study here reported was made on the University of California farm at Davis, California, from August 1926 to May 1927.

NATURE OF THE PROBLEM

The quality of work accomplished in plowing depends largely upon the shape of the bottom of the plow. A satisfactory model for certain field conditions can be obtained; the problem is to maintain the shape of the bottom as long as possible. The way to accomplish this is to choose material that will withstand the wear caused by the erosive action of the soil.

Maintaining suction of plowshares. It is a well known fact that vertical and horizontal suction of the plow bottom are important to secure good and even penetration. Ramsower (1917) defines vertical suction as the force that draws the plow into the ground; it is secured by dipping the point of the share downward below the bottom line of the landside. Horizontal suction is the force that helps keep the plow bottom to the land (unplowed portion of the field) thereby maintaining an even cut. As the shares dull through wear, these suction are weakened and the power of penetration is lessened. If the share is made of steel the point may be bent downward to secure vertical suction but not if it is made of chilled cast iron. But the bolts of a chilled cast iron share can be loosened and by inserting shims of tin or leather behind the bolts, the vertical suction may, in a measure, be restored. The hitch adjustment does not change the suction, which may help secure penetration.

Scouring by moldboards and shares. The moldboard is the part adjacent to the share. It is the function of the moldboard to turn over the

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furrow slice evenly after it has been cut by the share. When operating properly, a clean polished surface is maintained on both share and moldboard. This is called scouring. Failure to scour which means a greater draft and hence the need of more power, can be attributed to many causes but chiefly to soft spots, inequalities, and depressions in both share and moldboard, and to soil condition. A moldboard may be smooth and well polished yet after some hours of use it may fail to scour. For this condition, Bacon (1918) found that silicon, one of the soil components is mainly responsible. It scratches the surface of the metal leaving tiny grooves to which the clay sticks. This trouble may be prevented by using material for both share and moldboard hard enough to withstand this erosion of silicon. It has been found that chilled cast iron is sufficiently hard but it is impossible to manufacture free from depression shares and moldboards of this material; a condition that is secured when steel is used.

Disk penetration. The principles involved in the action of the disk harrow and disk plow are practically the same except that the disk plow is subject to a more severe test. The blades of both are usually of the same material. Ramsower (1917) found that the following factors influence the penetration of a disk harrow:

1. Angle of disks.
2. The weight of the harrow.
3. The sharpness of the disk.
4. Size of disks.
5. The dish of the disks.
6. The angle of hitch.

Of these factors the first three are the most important. The angle of disks which means the angle which the two gangs or sets of disks makes with each other can be directly adjusted by the operator. Weight can be put on the harrow if so desired. The sharpness of the disks and the subsequent maintaining of their size can be partly controlled by the materials from which they are made. The majority of farmers use their disks dull; few grind them. This means poor economy since the work is less satisfactory owing to lessened penetration.

IMPORTANCE OF THE PROBLEM

In the study of the possibility of introducing modern farm machinery into the Philippines for rice production, the writer became acquainted with the soil conditions in the rice growing regions of California. The soil is of dark gray to black clay. Jones (1923) found that because of the adobe structure of the soil, it is almost impossible to till it. The soil is sticky when wet, hard and full of cracks when dry. Because of these characteristics, it wears plow bottoms and harrow disks to a considerable degree as compared with ordinary soil conditions.

In the same study the writer found that it is almost impossible to introduce into the Philippines the large pieces of machinery because of the size of the individual farm, the unfamiliarity of the people with the machines, and the topography of the land in the irrigated districts which causes the construction of small checks. It may be possible that reduction of the present power requirements could be partly and directly effected by making specially designed plow bottoms out of the proper metal or alloy.

In the upland, or dry farming, lies the possibility of increasing the rice acreage in the Philippines. As the name suggests, in the upland rice growing the soil is worked dry, this subjects tillage implements to severe tests. The most common plow used is the moldboard type and when the soil is worked dry, dull shares and lost suction are very common. Furthermore, the upland rice farms are generally remote from towns where repair shops can be found. For these reasons, the putting out of specially made shares and moldboards that will resist excessive wear would save the farmers the trouble and expense of frequent repairing and, in a measure, would lower their power requirements. The same conditions apply to sugar cane growers.

MATERIALS AND MACHINERY

The disks and shares under test in this study obtained in the College of Agriculture of the University of California were from various companies selling farm machinery.

As a source of power, different tractors were used. Many of these tractors were loaned to the college by the manufacturers.

Disks

The harrow disks were of five groups marked 2 to 6 inclusive. The disks marked No. 6 were the regular disks now on the market. These are made of high carbon steel not heat treated. Nos. 2, 3, 4 and 5 are made of special steel and had been given various heat treatments. Disks marked No. 2 are the hardest of the lot, No. 3 are slightly softer and No. 4, still softer. No. 5 disks are softer than No. 4 but are considerably harder than No. 6.

The group marked No. 2 are disks which have been oil quenched but not drawn and the Brinell hardness on this material is about 444. Group No. 3 represent the same material as No. 2 with the same heat treatment plus a draw back in the furnace to a Brinell hardness of about 418. Group No. 4 represents disks from a different heat treatment; these contain slightly high carbon, but were bought to the same specification. These disks were oil quenched and then drawn back to a Brinell hardness of 418. Group No. 5 represents disks of the same specification material but drawn back further to a Brinell hardness of 387. Group No. 6 which are the regular disks marketed by one company have a Brinell hardness of approximately 207 to 235.

Shares

The shares under test were the chromium plated soft center steel and Krupp steel. Shares of ordinary chilled cast iron and soft center steel were used as reference shares to determine the relative amount of wear. In a previous series of tests conducted by the Division of Agricultural Engineering, University of California, manganese steel shares of different heat treatment were tested using also the ordinary soft center steel and chilled cast iron as reference. Data on these tests are given in table 3.

Chilled cast iron. Johnson (1919) describes chilled cast iron as follows:

Cast iron consists of metallic iron together with at least 1.5 per cent of carbon. It also contains silicon, sulphur, phosphorous, manganese, and other elements in greater or less proportion, but these may be regarded as impurities, though their presence is often useful or even necessary for the purposes for which cast iron is applied. Cast iron is fusible at a

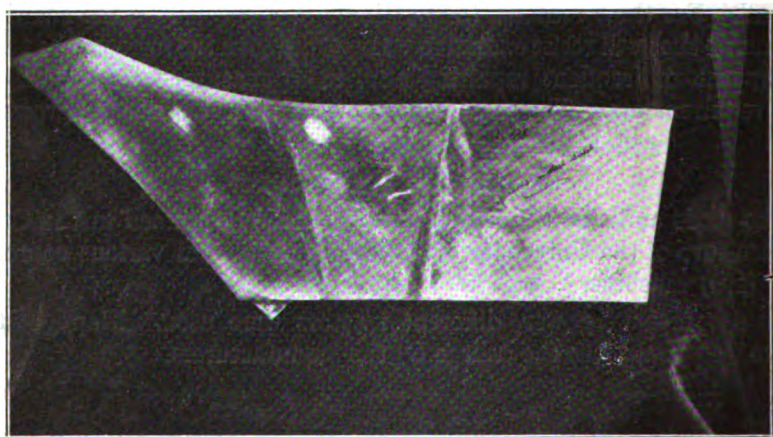


Fig. 1.—Upper surface of the chromium plated soft-center steel share. At the middle will be noted the portion with cooper-nickel plating without the chrome. The rest of the share was chrome plated.

temperature of about 2200° F. (1203.24° C.); when cold it is brittle and hard, some varieties being much more so than the others. Chills are used when it is desired to produce a casting the outside of which is unusually hard. The iron is generally a close grained gray, and this converted into white iron where it comes in contact with the cold side of the mould during solidification.

Soft center steel. Rynders (1920) gives the description of soft center steel share and its manufacture as follows:

Soft center steel is a laminated structure of three separate layers of steel. The outer layers are of high carbon or eutectoid steel, while the center layer is of a low carbon or hypo-eutectoid steel. In addition to these layers, it is the common practice to weld an extra high carbon steel pad on the greatest wearing surface of the share and moldboard thus giving a complicated structure of hypo-eutectoid, eutectoid, and hyper-eutectoid steels. The hardening temperature ranges of the three steels are about as follows: Hypo-eutectoid 1600°–1650° F. (860.24–898° C.); eutectoid, 1400°–1500° F. (759.24–814.74° C.); hyper-

eutectoid, 1350°–1400° F. (731.49–759.24° C.); allowance being made for 60° drop in temperature after removing from the furnace. The hypo-eutectoid layer is a low carbon steel, soft, tough and flexible; qualities which must be retained throughout the hardening process. It strengthens the outer layers to withstand the impact against stones in plowing the field.

Chromium plated soft center steel. In a letter to the writer, A. L. Collins, Electroplating expert, Berkeley, California, described the process of plating as follows:

The entire share was placed in a nickle bath for twenty minutes, and a copper bath for twenty minutes; then over the point was plated the chrome in a one-hour bath. The middle section was untouched and shows the final copper plating. The remaining section (the rear portion of the share) has chrome plate directly on the steel. The nickle and copper were buffed off before this operation. (See fig. 1 and 2.)

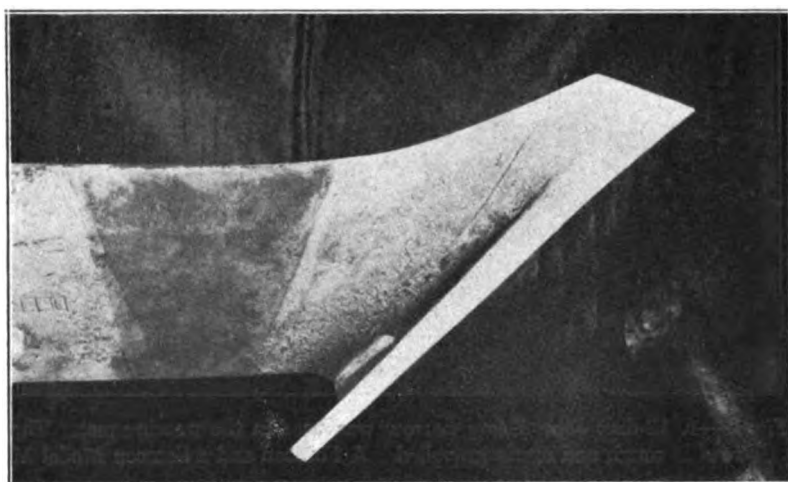


Fig. 2.—Bottom surface of the share of fig. 1.

Krupp steel. In a pamphlet, "Forged Plowshares" Friedrich Krupp describes this material thus:

This (the krupp steel) is a special brand of steel remarkable for its hardness and toughness. The shares of this material can be redrawn as the material is uniform throughout. For redrawing, the share should be heated to a temperature of about 950° to 1000° C. For hardening, the point edge should be reheated to about 780° to 800° C. and then immersed in hot water.

METHODS OF TESTING

Harrow disks

The disks were marked with center punch and then weighed four times on a scale reading to 0.01 pound (.0045 kgm.) taking the average as the representative weight. Then each disk, before using, was traced with the flat side down to determine the exact size. This tracing was later used to determine the amount of wear of each disk after subjecting them to use.

The disks were then attached to a single 12 disk John Deere harrow (see fig. 3 and 4).

The disks were then subjected to road work for fourteen hours, with the Fordson tractor for the first eight hours and the Samson for the last six hours. The road was sandy and gravelly thus giving the disks a good wearing test. The test lasted for 20 hours covering an approximate distance of 35 miles (57.315 km.).

Each disk was reweighed and retraced after the test, using the original tracing paper, one side coinciding with the same side of the first tracing, thus forming eccentric circles. By this method, the wear on one diameter is measured on one side of the tracing.



Fig. 3.—A 12-disk John Deere harrow was used in the wearing test. The road is rough and newly gravelled. A Fordson and a Samson Model M were used.

Plowshares

The shares were marked at the rear using an emery wheel because of their hardness. Each share was weighed four times carefully, taking the average as the representative weight. Each was traced in two positions to show both vertical and horizontal suction. The traced edges are generally the parts that received the greatest wear. After using the shares they were reweighed and retraced on the same tracing paper to determine the relative amount of wear.

The plow used for the test was a John Deere 3-12 inch bottom gang plow. The share under test was placed on the middle bottom with the front and rear shares of the reference material. For comparison of wear, the average wear of the front and rear shares was used.

Field and soil condition

In the plowshare tests two different fields were used. In the first test the field was so weedy that it was necessary to disk it first. The soil was

wet because of frequent rains previous to the test. These field conditions made the use of rolling coulters necessary (see fig. 5).

In the second test the field used was an old alfalfa sod which had been trampled by cattle. It was somewhat dry and the tramping of the animals had made the soil compact and hard. In both fields the soil is of the Yolo fine sandy loam, rather black and heavy.

DISCUSSION OF RESULTS

Harrow disks

Table 1 gives the data of the tests on the disks. The table includes weights before and after tests, average loss of weight of each group and their respective Brinell hardness number.



Fig. 4.—Weights were placed on both sides of the harrow to secure good penetration. They were approximately the same. During the whole test the gangs were set at full angle.

It may be observed that the average loss of weights of each group increases with the decrease of the Brinell hardness, excepting with No. 3 and No. 4. These disks have the same Brinell hardness but No. 4 shows slightly greater wear. According to the manufacturer's statement they are of different heat treatment and group No. 4 has a slightly higher carbon content.

Group No. 6 which are the usual disks on the market show the greatest amount of wear. The edges became dull more rapidly and were made irregular by being stressed beyond the elastic limit. Judging by the Brinell hardness, group No. 2 is about twice as hard as group No. 6 (Brinell hardness, 444: 207 to 235) yet there was no sign of breakage in any of the disks of group No. 2. The sharpness of disks, which is very desirable to obtain good penetration seems to be about four times as good in No. 2 as in No. 6.

Plowshares

The results on plowshare tests are grouped together in tables 2 and 3. Table 2 shows the tests on two shares made of chromium plated soft-center and krupp steels.

In the first test the wear of the chromium plated share placed on the middle bottom of the plow is slightly less than the average wear of the rear and front, the shares of the reference material (soft-center steel). However, after twelve hours of use it was found that the plating was entirely worn off and hence any further use would give only about the same wear as the reference shares. The slight difference can be attributed to the plating.

From the same table, it can be seen that the amount of wear on both reference shares in the first test was very much less than that of the reference



Fig. 5.—This field is an old alfalfa sod and previously trampled by cattle. The soil was compact, somewhat dry and very hard. Because of this condition a 30 H.P. Caterpillar tractor was used to pull the 3 bottom John Deere gang plow.

shares in the second test although the hours of use in the first test were twice that in the second. This unexpected difference was because of the moisture content of the soil and previous treatments of the fields.

Table 3 includes five series of tests marked A, B, C, D, and E.

In series A, the shares used were the soft-center steel, chilled cast iron, and manganese steel. The positions of each of these shares were interchanged after each third of a test was completed. Series B was a repetition of A, using duplicate shares. From these two tests the wear on the chilled cast iron share was the least, slightly more on soft-center steel, and most on manganese steel.

Series C was a test on the Hercules heat treated share placed on the middle bottom between two chilled cast iron shares. The wear was found to be more on the special steel and least on the chilled cast iron.

Series D was a test in a set of three manganese steel shares with different heat treatment. The differences in wear were very slight and it was due in part to the positions of the shares, that is least wear on front share and slightly more on rear.

Series E was of the same set of shares used in series D, that is, cold hammered to restore vertical suction. To compare their relative wear, this test was run without interchanging the positions of the shares. It was confirmed that the wear in front is the least and in the rear the most.

SUMMARY AND CONCLUSIONS

1. The usual disks on the market at present are rather soft and can be improved by hardening.

2. Although disk group No. 2 is about twice as hard as No. 6, as indicated by their respective Brinell hardness, there was no sign of breakage in any one of them. This condition was also true with the other groups. Because of these properties of group No. 2, it would be to the advantage of the farmers if disks under this group were put on the market.

3. Chilled cast iron shares show a slightly less wear than the soft-center steel shares.

4. Manganese steel which was thought to be hard enough for shares was found to wear out faster than either the soft-center steel or the chilled cast iron.

5. The chromium plating on the soft-center steel shares was soon worn off.

6. Krupp steel share showed slightly less wear than the soft-center steel.

7. Soft-center steel share maintained a higher polished surface than the Krupp steel.

8. The wear of plow bottoms is likely to be different in front and rear.

9. The parts of the share that receive the greatest wear are the point, edge, and just beneath the point; wear in the point destroys the vertical suction.

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TABLE 1
Wear of harrow disks

GROUP NO.	WEIGHT BEFORE TEST	WEIGHT AFTER TEST	LOSS OF WEIGHT	AVERAGE LOSS OF WEIGHT	BRINELL HARDNESS	REMARKS
	<i>kgm.</i>	<i>kgm.</i>	<i>kgm.</i>	<i>kgm.</i>		
2	3.150	3.141	0.090	—	444	No. 3 and 4 have same Brinell hardness but No. 4 has a slightly higher carbon content.
2	3.155	3.150	.005	—	444	
2	3.168	3.164	.004	0.006	144	
3	3.073	3.064	.009	—	418	
3	3.014	3.005	.009	0.009	418	
4	2.991	2.973	.018	—	418	
4	3.132	3.118	.014	0.016	418	
5	3.050	3.036	.014	—	387	
	2.909	2.886	.023	—	387	
5	3.032	3.009	.023	0.020	387	
6	3.041	3.014	.027	—	207-235	Ordinary disks.
6	3.114	3.082	.032	0.029	207-235	

NOTE: The work was done on a rough, newly gravelled road. Tractors used were a Fordson and a Samson Model M. The average speed was about 2.5 miles (4.023 km.) per hour; the hours used, 14; distance covered, 35 miles (57.315 km.). Each weight of disk as here given is the average of four weighings.

TABLE 2
Wear of plowshares

MATERIAL STEEL	WEIGHT BEFORE TEST	WEIGHT AFTER TEST	LOSS OF WEIGHT	TEST SERIES	HOURS USED	SOILS	REMARKS
	<i>kgm.</i>	<i>kgm.</i>	<i>kgm.</i>				
Soft-center.....	4.736	4.727	0.009	1st	12	Moist fine sandy loam	Front
Chromium plated soft-center.....	4.859	4.850	0.009	1st	12	" "	Middle
Soft-center.....	4.755	4.726	0.029	1st	12	" "	Rear
Soft-center.....	4.968	4.909	0.059	2nd	6	Hard puddled sandy loam	Front
Krupp.....	5.086	5.041	0.045	2nd	6	" "	Middle
Soft-center.....	4.863	4.791	0.072	2nd	6	" "	Rear

NOTE: The tractors used were a Cletrac, 2-Ton Caterpillar, and a 30 H.P. Caterpillar. The average plowing speed was about 2.4 miles (3.862 km.) per hour.

TABLE 3

Wearing test of plowshares; tractor speed about 2.8 miles (4.505 km.) per hour

MATERIAL	ORIGINAL WEIGHTS	LOSS OF WEIGHT	HOURS USED	SOILS	TEST SERIES	REMARKS
	<i>kgm.</i>	<i>kgm.</i>				
Manganese steel.....	4.068	0.377	106	Sandy loam	A	Shares interchanged as to position after each approximate one-third of useful life.
Chilled iron.....	5.126	0.250	106	"	A	
Soft-center steel.....	4.950	0.205	106	"	A	
Manganese steel T. W. I. and S. Co...	4.105	0.155	13.5	Dry sandy loam	B	Position on gang plow front share.
Chilled iron.....	4.959	0.050	13.5	"	B	Position on gang plow middle share.
Soft center steel.....	4.695	0.100	13.5	"	B	Position on gang plow rear share.
Chilled iron.....	4.900	0.141	28	Alf. sod. syd. loam	C	Position on gang plow-front share.
Special steel.....	4.377	0.204	28	"	C	Position on gang plow-middle share.
Chilled iron.....	5.023	0.177	28	"	C	Position on gang plow rear share.
Manganese steel Am. M. S. Co.	4.441	0.155	29.5	"	D	Position on gang plow front share.
Manganese A. M. M. S. Co.	4.818	0.205	29.5	"	D	Position on plow middle share.
Manganese Am. M. S. Co.	5.059	0.214	29.5	"	D	Position on plow rear share.
Manganese steel Am. M. S. Co.	4.741	0.041	12	Sandy loam	E	Front share. Vertical suction restored by cold hammering.
Manganese steel Am. M. S. Co.	4.609	0.23	12	"	E	Middle share. Vertical suction restored by cold hammering.
Manganese steel Am. M. S. Co.	4.282	0.036	12	"	F	Rear share. Vertical suction restored by cold hammering.

A STUDY OF CERTAIN CHEMICAL TREATMENTS IN RELATION TO SEED-BORNE DISEASES OF CALAUAN YELLOW FLINT MAIZE¹

VALERIANO C. CALMA, LORENZO G. PADERNA
AND MACARIO A. PALO

Corn (*Zea mays* L.) is the second important crop in the Philippine Islands. In some provinces it constitutes the principal food of the people. In 1925 there were 552,380 hectares of land planted to corn in the Philippines and the crop was worth ₱30,767,250². No survey of crop losses caused by the ravages of diseases has been made, but Baker (1917) and Reinking (1918) estimated them at about 10 per cent annually, which would mean a yearly loss of a few million pesos.

Seed-borne diseases are an important source of loss in growing corn. They either kill the seedlings or so weaken the plants that they easily succumb to the attack of other diseases. Weakened plants generally produce diseased ears which form sources of inocula for the neighboring plants and for the following crop.

The most practical method of controlling seed-borne disease is by careful seed selection while the corn is in the field. Holbert and Hoffer (1920) recommend that only matured ears of at least medium size from upright, sturdy stalks, or plants whose stalks and portions of the leaves are still green and whose ears are supported at a convenient height on strong and sound shanks should be selected for seed purposes. Ears that are sound may be singled out from among the diseased ones by the bright rich luster, plump, clean kernels, with well-developed germs, shallow and smooth indentation and decidedly horny endosperm. The shank attachment should be clean and free from any discoloration.

The study of the merits of poisonous compounds bearing certain trade names was made by treating the kernels of Calauan Yellow Flint maize harvested in the native way with the dust and solution of these substances. The soundest looking kernels of this corn often have incipient infections of seed-borne diseases. The work was conducted from October, 1924 to January, 1926 and from October, 1926 to February, 1928.

¹Based on two theses presented for graduation with degree of Bachelor of Agriculture from the College of Agriculture by Valeriano C. Calma in 1926, and Lorenzo G. Paderna in 1928. This paper was written by Mr. Macario A. Palo. Theses and paper were prepared in Department of Plant Pathology under direction of Dr. G. O. Ocfemia.

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²One peso (₱1.00) = \$0.50 U. S. currency.

REVIEW OF LITERATURE

Bolley (1897) states that stinking smut of wheat is controlled by immersing the grains in 1 to $1\frac{1}{2}$: 1000 solution of bichloride of mercury and that oats soaked for two hours in $2\frac{1}{2}$: 1000 formalin solution gave a higher percentage of germination and a greater yield than the untreated seeds.

Braun (1920) states that copper sulfate solution is ineffective and detrimental to germinating seeds.

Leukel, Dickson, and Johnson (1926) used 1.0, 0.5 and 0.25 per cent of aqueous solutions of Uspulun, Semesan, Germisan and Corona and found after seven years of extensive experiments that Germisan gave the best results, Uspulun the next best and Semesan the poorest.

Reddy, Holbert, and Erwin (1927) soaked *Diplodia*-infected corn kernels in 0.4 per cent solutions of Semesan and Uspulun and 0.25 per cent Corona 620 solution and found that Uspulun-soaked kernels gave the best field stand, Semesan-soaked the second best, Corona 620-soaked the third, and the controls, the poorest. These investigators found also that the kernels soaked in Uspulun gave higher yields than those soaked in Semesan and Corona 620.

Reddy and Holbert (1928) report that *Diplodia* seedling-blight of sweet corn can be controlled by dust or liquid treatment of the seed with any of the compounds including Semesan, Uspulun, Corona 640, Bayer dust and many others that they tested.

Holbert, Reddy, and Koehler (1928) found in their experiments on the chemical-dust seed treatments for dent corn that varieties differ in the degree to which they are benefited by those treatments and that they are not always followed by an increase in yield. These authors used Bayer dust, Improved Semesan Jr., and Merko.

MATERIALS AND METHODS

Seed

Ears of Calauan Yellow Flint maize were obtained from the Department of Agronomy. The kernels two centimeters from the butt and five centimeters from the tip of the ears were discarded so that only large and fairly uniform kernels were used.

Chemicals

Copper sulfate, sulfur powder, formaldehyde, Derris powder, mercuric chloride and organic mercury compounds known under the trade names of Germisan³, Uspulun⁴, Semesan⁵, Corona 640⁶, Corona 640-S⁷, and Colloidial copper⁸ were used.

³Obtained from Saccharin-Fabrik in Germany.

⁴Obtained from Bayer Company of New York.

⁵Obtained from E. I. Du Pont de Nemours Co., Inc., Wilmington, Delaware.

⁶, ⁷, ⁸Obtained from Pittsburgh Plate Glass Company, Corona Chemical Division, Milwaukee, Wisconsin.

Formalin and mercuric chloride were used in the form of solutions which were prepared in concentrations of 0.1 per cent and 0.2 per cent. Germisan, Semesan, Uspulun, Colloidal copper, copper sulfate, Corona 640, and Corona 640-S were prepared in concentrations of 0.25 per cent, 0.50 per cent, 0.75 per cent and 1.0 per cent. Germisan, Uspulun, Corona 640, and Corona 640-S were used also in the form of dust with Bayer's Dipdust and Special dust and powder of *Derris elliptica*, *Derris polyantha*, and *Derris philippinensis*.

Determination of the seed-borne flora of Yellow Flint maize and the tissues wherein the organisms are carried

The seed-borne flora of the maize was determined by plating out the entire kernels of corn, kernels without seed coat, endosperms alone, and embryos alone on potato-dextrose agar, agar in water, and nutrient agar in petri dishes. The results obtained are summarized in table 1.

TABLE 1
The fungous flora of Calauan Yellow Flint maize

ORGANISMS OBTAINED ^a	PERCENTAGE INFECTION OF PARTS PLATED OUT ON POTATO-DEXTROSE AGAR, WATER AGAR, AND NUTRIENT AGAR.			
	Entire kernels	Kernels without seed coat	Endo- sperm alone	Embryo alone
<i>Fusarium</i>	100	80	80	70
Black mold.....	100	70	70	70
Yellow mold.....	40	20	10	30
Blue mold.....	20	10	20	10

^a No effort was made to determine the identity of the *Fusarium* and molds obtained.

It may be seen in table 1 that *Fusarium* sp. and black mold are the predominating fungous flora in the seeds of Calauan Yellow Flint maize.

Tests of the efficiency of the chemicals used

The corn kernels were immersed in the solutions of Germisan, Uspulun, Semesan, Formalin, mercuric chloride, copper sulfate, Corona 640, Corona 640-S and Colloidal copper in test tubes for varying lengths of time covering the kernels to a depth of at least one centimeter. Every treatment had a control in which the kernels were soaked for the same length of time in sterile water. After the treatment, the corn kernels, including those in the checks, were spread on large filter papers to air-dry. Then the kernels were planted in sterilized soil in boxes. The plants were observed daily to determine the date of emergence, the percentage of germination, and condition of seedlings.

In the dust treatments the kernels were moistened with sterile water and then rolled until they were thoroughly covered with the fine powder of Germisan, Uspulun, Semesan, Dipdust, Special dust, Corona 640, Corona 640-S, powder of *Derris elliptica*, *Derris polyantha* and *Derris philippinensis*. The kernels used as control were moistened with sterile water as described by Leukel, Dickson, and Johnson (1926).

To determine the effect of the treatment on the production of ears, tests were conducted in the field. Only the concentrations and the lengths of immersion from the laboratory tests which indicated beneficial effects upon the seedlings and effectiveness in the control of seed-borne organisms were used.

The solutions used in field tests and their concentrations and lengths of immersion are given in table 2.

The dusts were not used in field tests because the seedlings from the treated kernels were the same as those of the control, and in some instances the treated seeds were poorer than those of the control. This result is in accord with the experience of Leukel, Dickson, and Johnson (1926) but contrary to that of Reddy and Holbert (1928) who reported that dust seed treatments for the control of *Diplodia* seedling blight of sweet corn are as beneficial as the liquid treatments and have the additional advantage of being more easily applied and involving less injury to the seed.

RESULTS

Laboratory experiments

In the laboratory experiments, soil sterilized with heat and placed in seed boxes was used. Previous to the tests with the chemicals, experiments carried on to determine whether or not soil sterilization has deleterious effects upon corn seedlings showed that it produces beneficial effects.

The criteria used for measuring the effects upon the corn of the various treatments in laboratory tests were: (1) height of the seedlings from fixed points on the surface of the soil to the tips of the longest leaf; (2) size of the shoots; (3) extent of the root systems; and (4) color of the vegetative parts as compared with those from untreated kernels.

Of the different chemical solutions used in the laboratory experiments, Germisan gave the best stand of seedlings. It was followed in success by formalin, next by Uspulun, then by Semesan. Mercuric chloride solution gave the poorest result.

Field experiments

Wet and dry season plantings were carried on in the experimental plot of the Department of Plant Pathology. The chemical solutions which showed controlling effects of seed-borne organisms and produced stimulatory effects upon the seedlings, and the lengths of immersion in these solutions

which gave the best results in the laboratory tests were tried out in the field.

Unfortunately, the soil of the plot that was assigned to the field trials was very poor because it had been planted to sugar cane, rice, tobacco, and corn repeatedly. The land was thoroughly prepared and furrows run 75 centimeters apart. During the wet season only one corn kernel was planted in each of the hills which were 70 centimeters apart in the furrows. In the dry season planting two kernels were planted in hills which were 75 centimeters apart. In both wet-and dry-season trials the treated corn kernels and the checks were planted in alternate furrows. The percentage of emergence in the wet-and dry-season tests did not agree with the percentage of germination in the laboratory tests. It was found that in the wet season plantings there was a higher percentage of emergence than in the dry season plantings.

When the plants were about 30 centimeters tall, leaf spots caused by *Ophiobolus heterostrophus* Drechsler and leaf blight caused by *Helminthosporium inconspicuum* Ell. and Evht. were present on the leaves of the plants. There were more leaf diseases in the wet season crop than in the dry season planting.

The tasseling of the corn of the wet-and dry-season plantings was not affected by the treatments. Both the control and the plants from treated kernels tasseled at about the same time.

The number and weight of the ears from each row and the number of diseased ears and nubbins were noted. The results are given in table 2.

The results obtained from the wet and dry season plantings of treated kernels may be summarized as follows:

1. None of the treated kernels in the wet and dry season plantings in the field gave 100 per cent germination. In some cases there were control kernels that gave a higher percentage of emergence than the treated kernels.
2. The wet season planting gave higher percentages of germination than the dry season planting.
3. All plants from treated kernels gave higher yields of ears than those of the control kernels.
4. The wet season planting produced more and larger ears than the dry season planting.
5. There were more diseased ears in the wet season planting than in the dry season crop.

As shown in table 2 the treatment that gave the highest yield with the use of formalin, mercuric chloride, Semesan, and Uspulun in the wet season planting did not give correspondingly the highest yield in the dry season planting. The kernels that were soaked in 0.25 per cent solution of Germisan for 8½ hours, however, gave the best yield in both wet and dry season plantings. By close inspection of the data in table 2 it may be seen that the formalin treatments that may be recommended to use for the control

of seed-borne diseases of Calauan Yellow Flint maize is immersion of the seeds for 7 hours in 0.1 per cent and $5\frac{1}{2}$ hours in 0.2 per cent solution of this chemical. With mercuric chloride the treatments that gave beneficial results were .01 per cent for 5 hours and 0.02 per cent for $4\frac{1}{2}$ hours; with Semesan 0.50 per cent and 0.75 per cent for $2\frac{1}{2}$ to $3\frac{1}{2}$ hours; and with Uspulun 0.5 per cent for 4 to $4\frac{1}{2}$ hours and 0.75 per cent for $3\frac{1}{2}$ hours.

Of the liquid treatments the results of which are shown in table 2, Germisan proved to be the best of all. Uspulun was second best and Semesan came third. The beneficial effects of these three chemicals upon corn agree with those reported by Leukel, Dickson, and Johnson (1926). Mercuric chloride and formalin, though slightly beneficial in a way, gave poorer results than either Germisan, Uspulun or Semesan. The average yield obtained from the treatment with formalin and with mercuric chloride was almost the same.

Table 2 shows also that none of the seed treatments completely rid the subsequent crop of disease in the ears. Diseased ears were obtained from both wet and dry season plantings with the exception of Uspulun-soaked seeds which did not produce any diseased ear in the dry season planting. Fewer diseased ears were obtained from the Germisan seed treatment than from any of the other chemical treatments given in table 2. The greatest number of diseased ears was obtained from mercuric chloride seed treatment.

DISCUSSION OF RESULTS

In this work it was noted that the kernels of Calauan Yellow Flint maize, although they appear healthy, may carry *Fusarium* and black, yellow, and blue molds on or within the kernels. The kernels treated with weak aqueous solutions of Germisan, formalin, Uspulun, Semesan and mercuric chloride gave a higher percentage of germination and better growth of seedlings than the control. Reddy and Holbert (1928) state that the roots of sweet corn grow rapidly into the soil and the aerial parts develop early when the treatment controlled the disease without any injury. These authors used Uspulun, Semesan, Corona 640, and other chemical dusts. Tisdale, Taylor, and Griffiths (1925) found that aqueous solutions of Germisan, Semesan, and Uspulun give excellent results in the control of barley smut. In these authors' experiments, Germisan, Uspulun, Semesan, Dip-dust, Special dust, Corona 640, and Corona 640-S dusts were found to be unsatisfactory in the control of smuts of oats and barley. Leukel, Dickson, and Johnson (1926) found that dust treatment failed to give any satisfactory results in the control of barley stripe. Calma and Paderna also found that chemical dust treatment for the control of *Fusarium* and molds in the seed of Calauan Yellow Flint corn was of no avail. Of the chemicals used in solution in the laboratory and field tests they noted that Germisan was the best substance for seed treatment of corn. They found that formalin treatment was next to Germisan in laboratory tests but in field tests Uspulun was much better than formalin in the production of ears.

The results obtained by Calma and Paderna during wet and dry season plantings are in accord with those of Leukel, Dickson, and Johnson (1926). Their results also agree with those of Reddy, Holbert, and Erwin (1927) who state that sweet corn kernels treated with Uspulun solution gave a higher yield of ears than those treated with Semesan and Corona 640.

In wet and dry season plantings, Calma and Paderna noted that there was no difference in the time of emergence of seedlings between the treated and the control plants. All corn kernels in the treated and control rows emerged after three days from the time of planting. Plants from treated kernels during wet and dry season plantings were of course more vigorous and gave a better stand than those of the controls.

The treated kernels planted during the dry season produced ears that were much less infected than the treated kernels planted during the wet season. The average size of ears produced from the treated seeds during the wet and dry season crops was larger than the average size of ears produced in the control. In the wet season crop the average size of ears from the treated seeds were larger than the average size of ears from the treated seeds in the dry season crop. The ears produced from treated kernels planted during the dry season were poorer than those produced during the wet season. The difference in production between the treated seeds and the control was very marked in both the wet and dry season plantings.

The use of these organic mercury compounds is prohibitive under our present farming conditions in the Philippine Islands. As they are deadly poisonous to man and animals extreme care should be taken when handling them. However, the writers believe that, at least for technical purposes, Germisan, Uspulun and Semesan merit further tests not only with maize but with other seeds.

SUMMARY

1. *Fusarium*, black, yellow, and blue molds are the seed-borne fungi in the kernels of Calauan Yellow Flint maize.
2. The fungi are carried on the seed coat, and in the endosperm and embryo of the kernels.
3. Treatment of seeds with chemicals in the form of aqueous solutions produced beneficial effects on the seedlings in the wet and dry season plantings and controlled the seed-borne diseases. The treatments did not affect the time of emergence and the tasseling of corn.
4. Of the five chemicals used for treating the kernels for the wet and dry season plantings, Germisan gave the best results in the production of ears. Uspulun ranked second as to production of ears and control of seed-borne diseases. Semesan ranked third, and formalin, fourth. Mercuric chloride solution gave the poorest results of the chemicals used, although treated kernels produced a yield higher than the control and it reduced the amount of injury caused by seed-borne diseases.

5. More disease-free ears were produced from kernels treated with the five chemical solutions than from the control.

6. Aqueous solutions of Germisan, Uspulun, and Semesan merit further tests for seed treatment in technical ways not only with maize but with other grains or seeds. As these preparations are deadly poison to man and animals and are also expensive they will not become popular under Philippine conditions.

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THE USE OF STEAM IN KJELDAHL NITROGEN DETERMINATION¹

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WITH TWO TEXT FIGURES

The apparatus which is generally used for the distillation of ammonia in the usual Kjeldahl methods consists of tin spiral tubes arranged in a series of six, twelve or more and immersed in a water filled copper tank which serves as the condenser. The Kjeldahl flask containing the digested and alkali treated sample is connected to the upper end of a tin tube by means

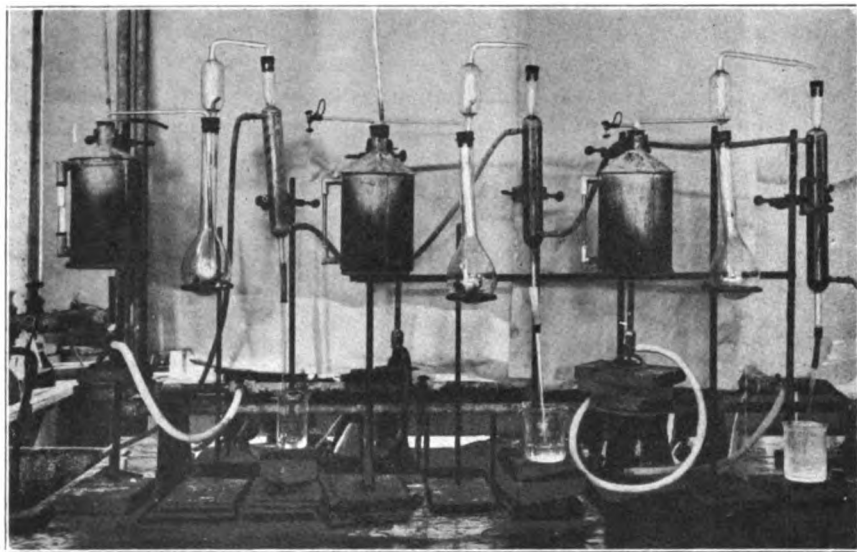


Fig. 1.—Steam generator for (ammonia) nitrogen distillation (Kjeldahl).

of ammonia safety bulb, the other end of the tube being dipped into the receiver by means of a glass tube connection. The flask is heated by means of burners. This method of distillation usually gives rise to too much bumping, frothing, and boiling over of the sample. In many cases bumping is prevented, at least partially, by the use of anti-bumping materials such as paraffin, pieces of coal, zinc, etc. One who has performed the determination of nitrogen in soils is familiar with the inadequacy of these anti-

¹Experiment Station contribution No. 582.

bumping materials. Although the usual distillation procedure is accompanied with the difficulties named, the method is used in many laboratories and most analysts continue to use anti-bumping materials. What is surprising is that the use of steam distillation has not received general adoption. One needs only to try the method to appreciate its many advantages over the usual methods.

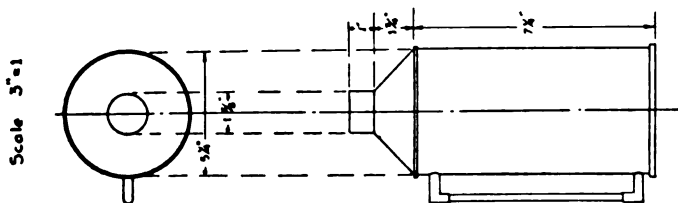


Fig. 2.—Modified Kjeldahl distilling apparatus showing steam generators.

The apparatus for the steam distillation of ammonia nitrogen can be easily set up out of ordinary Liebig condensers, ammonia bulbs, and the steam generator. This last can be made out of a plain galvanized iron sheet. One which the author is using in his laboratory with satisfactory results has the measurements shown in figure 2. A whole set-up of the apparatus is also shown in figure 1.

The author is indebted to Professor Geo. W. Cavanaugh of Cornell University for the idea of setting up the ammonia distilling apparatus with the use of steam.

ACCURACY IN THE WEIGHING OF EXPERIMENTAL CHICKENS¹

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The use of poultry, both inside and outside the laboratory, has become very general in various studies owing to the ease with which these animals adapt themselves to changes in environment. In many of these studies, the weights of the individuals are often the criteria used in the determination of the effects of the treatment to which they are subjected. Because of the daily activity of fowls made necessary by their habits in search for food it would seem that these weights may vary somewhat at different hours of the day. The factors which may cause variations in the weights of chickens at different hours of the day are, in the main, intake of feed and water and movement of the bowels.

In weighing experimental chickens, to overcome the effects of these various factors, it is usually recommended that the chickens be weighed regularly at certain hours of the day. The weighing is usually done early in the morning just before the birds are given their first meal for the day. Atwood (1928)² claims that at this time "the body weight may be obtained more accurately than later in the day when the amount of feed in the digestive system is more variable, also the laying of the birds is not interfered with, and they can be caught with a minimum of trouble and confusion". If this recommendation is followed, it necessitates, when a considerable number of chickens are weighed, delaying the breakfast of the fowls for some time. With hens this delay may influence their laying. To find a means by which the experimenter with fowls may be aided in the work of weighing his experimental animals was the object of this study.

The important questions that confront the poultry investigator are: Do the chickens have to be weighed at certain definite hours of the day to get uniform results? To what degree of accuracy must the chickens be weighed? Are the variations in the weight of the chickens due to the necessary vital activities of the birds so large as to cause significant differences in the results obtained? These questions and others are answered by the data given in this paper.

Literature along this line, is very meager. The only available study reported is that by Card (1920)³ whose studies with laying hens included

¹Experiment Station contribution No. 583. Read at the meeting of the Los Baños Biological Club on October 4, 1928. Received for publication November 12, 1928.

²Atwood, Horace. 1928. Notes on weighing mature fowls in experimental work. *Poultry Science* 7: 67-68. *Fig. 1-2.*

³Card, Leslie E. 1920. What precision is worth while when weighing hens? *Journal of the American Association of Instructors and Investigators in Poultry Husbandry* 7: 7-8.

the weighing of forty-nine S. C. White Leghorns at hourly intervals from 8:00 a. m. to 6:00 p. m. From his studies he concluded that the greatest accuracy was obtained by weighing at 1:00 p. m. According to his report the differences of the mean weights, however, were small, and it is very doubtful whether these differences would be significant if their probable errors were determined and compared. The birds were given a light normal feeding of grain at 8:30 a. m. and a heavy feeding at 5:15 p. m. Dry mash, grit, oyster shell, and water were available throughout the day.

The writer could find no recommendation concerning the weighing of chickens other than layers. Young chickens are commonly employed as laboratory materials in nutrition and other studies. For this reason in this study the weighing of young as well as of mature chickens was studied with the view of determining just what the best system of weighing should be in order to get the most accurate weights possible. In the present report, the data include the weights of 68 Cantonese chicks one week old, the weights of 35 weanling Cantonese chickens eight weeks old and the weights of 48 mature Cantonese pullets. The last group varied from about 8 to 14 months in age.

The birds were weighed in a pan balance sensitive to one one-hundredth of a gram. The weights of each group were determined in one day at intervals of two hours, from 6:00 a. m. to 6:00 p. m. Weighing at one hour interval will interfere very materially in the day-to-day activities of the chickens. This is true especially with the young chicks which are not benefited by too much handling. Besides, the chickens will be prevented from feeding normally if they are handled at intervals closer than two hours, as it took slightly over a minute to weigh each individual accurately enough for the purposes of this study.

The chickens weighed were treated in as normal a way as possible. All were given a light grain feeding about 7:00 a. m., the chicks a heavy grain feeding about 4:00 p. m., and the mature fowls about 5:00 p. m. Dry mash was open to them at all times. In addition to this, about 11:00 a. m., they were given wet mash enough to last them about fifteen minutes. Water and grit were available throughout the day.

RESULTS

The results obtained in this study are given in tables 1 to 6. In table 1, the variations in the mean weights of the different groups of chickens used are given together with their respective probable errors. The averages for the day were determined by adding the bi-hourly weights to get the individual average weights for the day, and the means of these were determined. These are given in the last line of table 1. In this connection the following question may be asked: Can these averages be taken to express the real weights of the fowls for the day? There is no apparent reason why they may not as they represent the weights of the birds determined at bi-

hourly intervals throughout the same day. Then, how would the weights determined at each weighing compare with these "real" weights of the birds? To answer this question, reference should be made to table 2. The differences between the mean weights taken at intervals of two hours and the average of these weights for the day, together with their probable errors are given in this table.

It is of interest to make comparisons of the mean weights determined at different intervals, two, four, and six hours, to see if the variation at these different hours are significant. These mean weights with probable errors, are given in tables 3, 4, and 5, respectively. Table 6 gives the differences between the mean weights determined at six o'clock in the morning and at six o'clock in the evening.

DISCUSSION

By reference to table 1, it may be seen that in all the three groups of chickens studied, the mean weights varied in practically the same way. The mean weights determined at 6:00 a. m. increased after the morning feeding of grains. In the case of one-week old chicks, very little weight is added from this hour up to 12:00 noon, but in case of the larger birds, the feeding of the wet mash before noon caused an increase in the weight at twelve. Both the one-week old chicks and the weanlings slightly increased in weight from 12:00 noon to 4:00 p. m., when the maximum weights for the day were registered in both groups. After 4:00 p. m., the chicks in both groups were practically idle, waiting for the roosting hours in the evening, hence their weights either decreased, as was the case with the week-olds, or were maintained, as with the weanlings. A slightly different story is presented by the mature fowls. From 12:00 m. to about 4:00 p. m., these birds were idle, or, in most cases, they were laying eggs. So, during these hours they did not fill up with feed, hence the weight was either maintained or because of the heavy egg production which generally takes place some time during these hours the weight was decreased. Then, as soon as they get a chance, the fowls fill up for the evening, registering the highest weight for the day, at 6:00 p. m. A similar variation was observed by Card (1920)⁴ among White Leghorn hens.

From the probable errors of these different determinations it may be seen also that it will not be worth while to carry the weights of mature fowls closer than fifteen grams, of the weanlings, five grams, and of the one-week old chicks one-half gram. The weights of the hens were observed to be most variable early in the morning, a fact contrary to general expectation. The claim of Atwood (1928)⁵ that about this time the body weight may be obtained more accurately than later in the day may be true if the chickens are not allowed to leave the roost before they are weighed. In this study, however, the birds were allowed out from daylight to weighing time at 6:00

⁴, ⁵ *loc. cit.*

a. m. The "early birds" had a chance to go around and pick up whatever grain may have been left from the previous evening grain meal and in addition they obtained some food from the mash hoppers. The worms and insects and green grass that these "early birds" picked up from the yards also contributed to the variation.

If the averages of the bi-hourly weights are taken as the real weight of the fowl on that day, a comparison of the differences between these weights and the average for the day, as may be seen in table 2, reveals the fact that among the weanling and the yearling chickens, these differences are not significant. With the one-week old chicks, these differences are not significant except those recorded at 6:00 a. m. and those taken at 5:00 p. m. The mean weight at 8:00 a. m. and that at 2:00 p. m. are only fairly significant. Outside of these in all the groups of chickens weighed, the differences are not significant. Thus, it is very significantly shown that experimental fowls may be weighed at almost any hour of the day and the weights thus obtained will be close enough to the real weight of the fowls, and the difference will be small enough to be within the limits of its probable error.

When the mean weights of the fowls in all groups determined at intervals of two and four hours are compared, it may be seen in tables 3 and 4 that the differences between them are also not significant. However, among one-week old chicks, if the interval between the weighing is stretched to six hours, as for example between 6:00 a. m. and 12:00 m., the differences between the means become significant. Thus, if one set of weights is taken at a certain hour, and another set is taken six hours later on the same day, the means of these weights according to the results of this study will vary, and this variation is significant. This is true only in the case of the one-week old chicks; it does not hold as the chickens grow older.

The differences between the early morning weights and those taken in the evening of the same day are significant in all the groups of chickens weighed. In practice, however, weighing at such wide intervals is not done, and therefore errors arising from this source may be considered practically nil. It may be safely concluded, therefore, that experimental chickens may be weighed almost any time of the day and variations in the weights are not significant, except when one weighing is made early in the morning and another is made at 6:00 p. m.

SUMMARY OF CONCLUSIONS

1. The weights of chickens vary throughout the day, the amounts of these variations depending upon the size and the activity of the fowls. These variations, however, are not great enough to be significant.

2. It was concluded that in weighing experimental chickens it is not worth while to carry the weights of mature fowls (Cantonese) closer than fifteen grams, of the weanlings, five grams, and of one-week old chicks, one-half gram.

3. Weanling and yearling chickens may be weighed at any hour of the day and the weight will be close enough to the real weight of the bird for the day. If young chicks are weighed about noon the weight will be within a close range of the real weight for the day.

4. The differences between mean weights taken at intervals of two and four hours are not significant.

5. The differences between mean weights taken at intervals of six hours is significant only among young Cantonese chicks, but not among weanling and yearling chickens.

6. The difference between early morning weights and those taken in the evening are significant in all groups of chickens used in this study.

TABLE 1

Mean weights of Cantonese chickens determined at intervals of two hours, from 6:00 a. m. to 6:00 p. m.

TIME	ONE WEEK OLD	EIGHT WEEKS OLD	YEARLINGS
	<i>grams</i>	<i>grams</i>	<i>grams</i>
6	35.04 ± 0.464	137.07 ± 4.334	1283.82 ± 23.452
8	36.57 ± 0.489	142.79 ± 3.946	1305.71 ± 17.184
10	37.15 ± 0.528	142.21 ± 4.137	1315.09 ± 17.032
12	37.87 ± 0.527	145.07 ± 4.617	1331.74 ± 16.461
2	39.99 ± 0.575	148.50 ± 4.619	1331.74 ± 16.920
4	40.21 ± 0.564	152.50 ± 4.843	1323.48 ± 15.592
6	39.29 ± 0.502	152.50 ± 4.810	1348.42 ± 16.201
Average for the day	37.91 ± 0.559	146.12 ± 4.430	1320.33 ± 16.257

TABLE 2

Differences between mean weights taken at intervals of two hours and the average of these weights for that day

	ONE WEEK OLD	EIGHT WEEKS OLD	YEARLINGS
AVE- RAGE	<i>grams</i>	<i>grams</i>	<i>grams</i>
TIME	37.91 ± 0.559	146.12 ± 4.430	1320.33 ± 16.257
6	-2.87 ± 0.726	-9.05 ± 6.197	-36.50 ± 28.535
8	-1.34 ± 0.743	-3.03 ± 5.916	-15.62 ± 23.656
10	-0.76 ± 0.770	-3.91 ± 6.061	-4.24 ± 23.545
12	-0.04 ± 0.768	-1.05 ± 6.398	11.41 ± 23.136
2	2.08 ± 0.737	2.38 ± 6.400	11.41 ± 23.464
4	2.30 ± 0.787	6.38 ± 6.563	3.15 ± 22.523
6	1.38 ± 0.751	6.38 ± 6.538	28.09 ± 22.951

TABLE 3

Differences between mean weights taken at intervals of two hours

TIME	ONE WEEK OLD	EIGHT WEEKS OLD	YEARLINGS
	<i>grams</i>	<i>grams</i>	<i>grams</i>
6 and 8	1.53 ± 0.674	5.72 ± 5.861	21.88 ± 29.073
8 and 10	0.58 ± 0.719	0.58 ± 5.717	9.28 ± 24.195
10 and 12	0.62 ± 0.746	2.86 ± 6.198	16.65 ± 23.687
12 and 2	2.12 ± 0.778	3.43 ± 6.530	0
2 and 4	0.23 ± 0.803	4.00 ± 6.692	8.26 ± 23.005
4 and 6	0.92 ± 0.775	0	24.94 ± 22.470

TABLE 4

Differences between mean weights determined at intervals of four hours

TIME	ONE WEEK OLD	EIGHT WEEKS OLD	YEARLINGS
	<i>grams</i>	<i>grams</i>	<i>grams</i>
6 and 10	2.11 ± 0.702	5.14 ± 5.991	31.26 ± 28.983
8 and 12	1.30 ± 0.718	2.28 ± 6.073	26.03 ± 23.796
10 and 2	2.84 ± 0.778	6.29 ± 6.201	16.65 ± 24.007
12 and 4	2.34 ± 0.779	7.43 ± 6.691	8.26 ± 22.671
2 and 6	0.70 ± 0.761	4.00 ± 6.668	16.68 ± 23.425

TABLE 5

Differences between mean weights determined at intervals of six hours

TIME	ONE WEEK OLD	EIGHT WEEKS OLD	YEARLINGS
	<i>grams</i>	<i>grams</i>	<i>grams</i>
6 and 12	2.83 ± 0.702	8.00 ± 6.332	47.91 ± 28.652
8 and 2	3.42 ± 0.752	5.71 ± 6.075	26.03 ± 24.115
10 and 4	3.06 ± 0.772	10.29 ± 6.369	8.37 ± 23.089
12 and 6	1.42 ± 0.727	7.43 ± 6.667	16.68 ± 23.096

TABLE 6

Differences between mean weights determined at 6:00 a. m. and at 6:00 p. m.

AGE	DIFFERENCE	PROBABLE ERROR	REMARKS
	<i>grams</i>		
One week	4.25	± 0.683	Significant
Eight weeks	15.43	± 6.473	Fairly significant
Yearlings	64.59	± 28.503	Fairly significant

YIELDING POWER OF PEANUTS FROM CUTTINGS OF DIFFERENT AGES¹

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WITH THREE TEXT FIGURES

That some varieties of peanuts may be grown from cuttings under field conditions has been reported by the writer.² In the present paper the result of a short study on the determination of the yielding power of peanut cuttings from plants of different ages is reported.

The study was conducted in the Experiment Station field of the Division of Farm Crops of the Philippine College of Agriculture during the College year 1927-28 in connection with the course in Agronomy 13 (cereals and field legumes). The experiment was started on June 1, 1927, and closed on January 20, 1928.

MATERIALS AND METHODS

Three varieties of peanuts; namely, Kinorales, Lemery, and Tarlac were used in this experiment. So as to have cuttings from plants of different ages available for planting on the same date, seeds of the three varieties used were planted on June 1, July 4, and August 4, 1927. Cuttings from these plantings were planted in thoroughly prepared ground on September 29, 1927. This means that the cuttings used were taken from plants which were about two months, three months, and four months old, the last set being almost matured.

The different kinds of cuttings of the varieties used were planted side by side, each kind occupying two rows. The rows were 30 meters long and 80 centimeters apart. The cuttings were set at 30 centimeters intervals in the rows, with one cutting to the hill. For comparison, seeds of the different varieties were planted in adjacent rows. During the progress of the experiment, all the plants were cultivated and weeded in practically the same manner. In the last cultivation the soil was worked toward the plants, thus forming ridges along the rows of plants.

EXPERIMENTS AND RESULTS

The percentage of germination of the peanut seed and the percentage of rooting of the different kinds of cuttings were determined. The data

¹Experiment Station contribution No. 584. Received for publication, September 20, 1928.

²Rodrigo, P. A. 1927. Growing peanuts from cuttings. *THE PHILIPPINE AGRICULTURIST* 16: 13-18. Pl. 1; fig. 1-2.

are presented in tables 1 and 2. Table 1 presents the data for the individual varieties and table 2 is a summary of table 1.

The cuttings which were taken from plants of different ages showed marked differences in their rapidity to root and develop. The younger the cutting, the more rapid was the recovery. Figure 1 shows clearly the differences in the vegetative development of the cuttings of different ages.

When the plants were beginning to develop pods, there was a dry spell. All of the plants suffered from the effect of the drought, but the effect was very pronounced in the case of the plants propagated by cuttings. Upon examining the plants, it was found that the cuttings had poorly developed

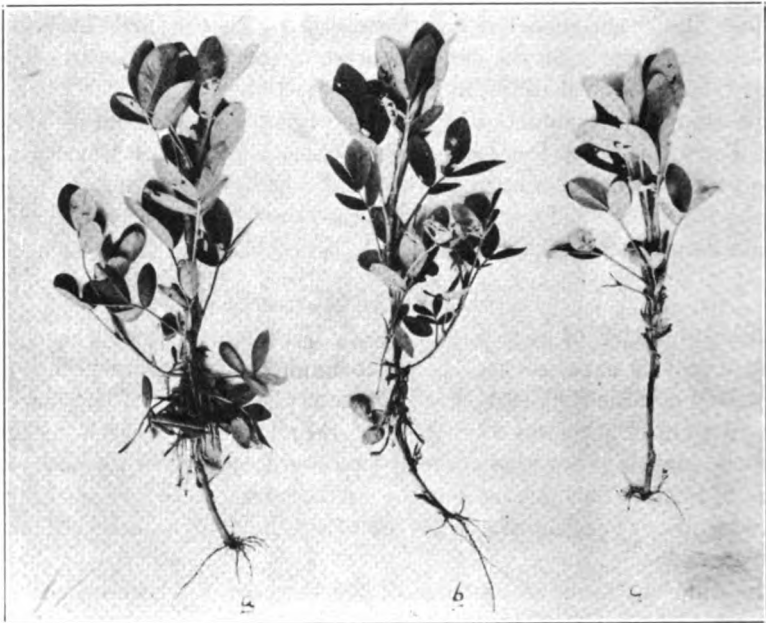


Fig. 1.—Plants forty-two days old grown from cuttings from (a) two months old, (b) three months old, and (c) four months old plants. (All photographs taken by the Photographic Division, College of Agriculture.)

root systems. The differences in the stand of the plants from seed and from cuttings and in their ultimate production may be traceable to the effect of the dry spell upon the development of the root systems.

At maturity, samples for the determination of the yield of straw and of pods were taken at random from the rows of all the propagating materials used. The soil adhering to the plants was washed off carefully with water before they were dried in the sun. The air-dry weight of the straw and of the pods of each plant was then taken.

The average yields of pods and of straw per hill or per plant including their respective probable errors were computed. Table 3 presents the

average yields per plant of the three varieties used and table 4 is a summary of table 3.

DISCUSSION OF RESULTS

Germination and rooting

The cuttings from plants two months, three months, and four months (maturing) old were able to produce plants that matured normally. There were, however, great differences in the percentage of their rooting, in their ability to recover and to develop vegetatively, as may be seen in figure 1; also in their producing power, as will be discussed later. There was very slight difference in the number of days to maturity; plants from seed and from cuttings matured at practically the same time, with those from the older cuttings showing a tendency to mature a bit later.

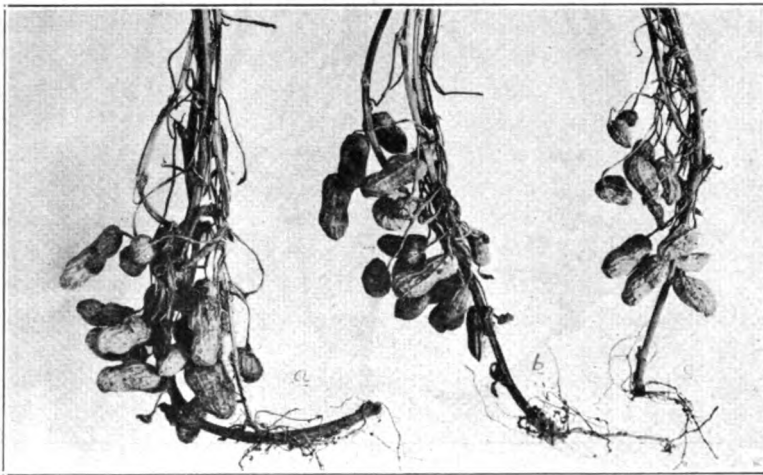


Fig. 2.—Matured Kinorales plants grown from cuttings of: (a) two months old, (b) three months old, and (c) four months old (maturing) plants.

In tables 1 and 2 are presented the percentage of germination of the seed and the percentage of rooting of the different kinds of cuttings. One very significant thing to note is that while the three varieties used showed differences in the percentage of rooting in the three ages of propagating material, the differences were constant. That is, the cuttings from the three months old plants gave the highest percentage of rooting in all varieties, followed by those from two months old plants; and the lowest percentage of rooting was obtained from cuttings taken from four months old, or maturing plants. The cuttings from variety Kinorales gave the best percentage of rooting; 98 per cent for the three months old cutting, 89 per cent for the two months old cutting and 76 for the four months old cutting. Variety Lemery gave fairly high percentages of rooting as may be seen in

table 1, but variety Tarlac had a rather poor percentage of rooting, 72.5 per cent for the two months old cutting, 70.5 for the three months old cutting and 12.5 per cent for the four months old cutting. The peanut seed of all the varieties used gave very poor percentages of germination because of the destruction of seed by ants; 13.5 per cent for Tarlac, 37.0 per cent for Kinorales and 21.0 per cent for Lemery. This low percentage, however, undoubtedly, gave the plants that grew ample room for rapid and vigorous development.

As to the average percentage of rooting of the three varieties, the cuttings from three months old plants had 88.00 per cent; those from two months old plants, 83.00; those from four months old plants, 55.56; and the seed, 23.85 per cent. In ability to root and grow, the cuttings from



Fig. 3.—Matured Lemery plants grown from cutting of: (a) two months old, (b) three months old, and (c) four months old (maturing) plants.

three months old plants were the best and those from maturing plants were the poorest.

Straw and pod yield

Straw yield. The average straw yields of the different propagating materials are presented in table 1. In all the three varieties, the plants from seed gave the highest straw production, the yield per plant being 26.2 ± 1.085 grams for Kinorales, 23.1 ± 1.203 grams for Lemery, and 8.1 ± 0.537 grams for Tarlac. While the plants from the cuttings of the youngest plants, (two months old) gave the highest yield, the differences were only slight for the different cuttings.

Pod production. In tables 3 and 4 are found the average yield of pods per plant of the propagating materials under study. As in the case of the

straw yield, the plants from seed gave the best production in all the varieties. The reason for the plants from cuttings giving lower pod production may have been the effect of the dry spell, as they had the poorer root systems. This dry weather was during the development of pods.

Of the plants from cuttings, those from young (two months old) plants gave the highest yield of pods per plant, and those from maturing (four months old) plants gave the lowest yield. Taking the average of the three varieties, the plants from two months old cuttings, gave 10.1 ± 0.372 grams of pods per plant; those from three months old cuttings, 8.2 ± 0.379 grams; and those from four months old cuttings, 6.7 ± 0.335 grams of pods. The difference between the pod production of the plants from two months old cuttings and those from three months old cuttings was significant, but the difference between those from three months old cuttings and from four months old cuttings was very slight.

It is significant and worth noting that while the three months old cuttings gave the highest percentage of rooting, the plants from two months old cuttings gave the highest production of straw and of pods. Since the two months old cuttings had a comparatively high percentage of rooting (83 per cent) they proved to be better for planting purposes. The cuttings from old or maturing peanut plants showed no economic value for planting purposes.

Although the best producers of pods and of straw among the plants from cuttings did not produce as much as the plants from seed, the use of peanut cuttings for planting purposes seems to have a place in the peanut industry. One of the direct causes of the small area devoted to peanut raising in the Philippines is the lack of good seed during the planting season. The area planted to peanuts could be increased by making a second planting by cuttings about 40 to 60 days after the peanut seed had been planted, which is in the early part of the rainy season. If a farmer would thus increase the area planted he could afford to increase his handling capacity. The method of peanut growing in the Philippines is such that it limits the area that can be handled by a farmer, mainly because of the absence of machinery to pick up and clean the pods.

SUMMARY OF CONCLUSIONS

From the data presented in this study the following conclusions may be drawn:

1. Cuttings from peanut plants of different ages, varying from two months old plants to four months old (maturing) plants were capable of rooting when planted under Los Baños field conditions. The cuttings from the three months old plants in the three varieties used had the highest percentage of rooting (70.5 to 98.0 per cent), those from the two months old plants had second highest (72.5 to 89.0), and those from maturing plants gave the lowest (12.5 to 78.0 per cent).

2. Of the plants from cuttings those from the two months old plants gave the highest pod yield; those from the three months old plants, second; and those from maturing plants, lowest. The average pod production of the three varieties was 10.1 ± 0.372 for the plants from two months old cuttings, 8.2 ± 0.379 from three months old, and 6.7 ± 0.335 grams from four months old.

3. In the straw production, there was only a slight difference in the average yield per plant; this was in favor of the plants from the two months old cuttings.

TABLE 1

Showing the percentage of germination of peanut seeds and of rooting of peanut cuttings of different ages

	NUMBER PLANTED	NUMBER GERMINATED OR ROOTED	GERMINATED OR ROOTED
			<i>per cent</i>
Kinorales:			
Seed.....	200	74	37.0
Cuttings from 2 months old plant.....	200	178	89.0
Cuttings from 3 months old plant.....	200	196	98.0
Cuttings from 4 months old plant.....	200	152	76.0
Lemery:			
Seed.....	200	42	21.0
Cuttings from 2 months old plant.....	200	175	87.5
Cuttings from 3 months old plant.....	200	191	95.1
Cuttings from 4 months old plant.....	200	156	78.0
Tarlac:			
Seed.....	200	27	13.5
Cuttings from 2 months old plant.....	200	145	72.5
Cuttings from 3 months old plant.....	200	141	70.5
Cuttings from 4 months old plant.....	200	25	12.5

TABLE 2

Showing the average percentage of germination of seed and of rooting of cuttings of different ages of three varieties of peanut

	PLANTED	GERMINATED OR ROOTED	GERMINATED OR ROOTED
			<i>per cent</i>
Seed.....	200	47.7	23.85
Cuttings from 2 months old plants.....	200	166.0	83.00
Cuttings from 3 months old plants.....	200	176.0	88.00
Cuttings from 4 months old plants.....	200	111.0	55.50

TABLE 3

Showing the comparative pod and straw production of peanut cuttings from plants of different ages

	AVERAGE YIELD PER PLANT	
	Pod	Straw
	grams	grams
Kinorales variety:		
Plants from seed.....	29.3 ± 1.089	26.2 ± 1.085
Plants from 2 months old cutting.....	12.0 ± 0.335	15.8 ± 0.890
Plants from 3 months old cutting.....	11.8 ± 0.486	14.4 ± 0.598
Plants from 4 months old cutting.....	9.1 ± 0.324	13.0 ± 0.741
Lemery variety:		
Plants from seed.....	14.9 ± 0.812	23.1 ± 1.203
Plants from 2 months old cutting.....	11.3 ± 0.483	13.9 ± 0.807
Plants from 3 months old cutting.....	8.5 ± 0.391	13.8 ± 0.627
Plants from 4 months old cutting.....	7.7 ± 0.301	16.6 ± 0.702
Tarlac variety:		
Plants from seed.....	9.4 ± 0.839	8.1 ± 0.537
Plants from 2 months old cutting.....	6.9 ± 0.298	5.7 ± 0.313
Plants from 3 months old cutting.....	4.3 ± 0.262	3.9 ± 0.329
Plants from 4 months old cutting.....	3.3 ± 0.391	5.6 ± 0.692

TABLE 4

Showing the average pod and straw production per plant of three varieties of peanuts

Pod production

	YIELD	DIFFERENCE	SIGNIFICANCE OF DIFFERENCE
	grams	grams	
Plants from seed.....	17.9 ± 0.913		
Plants from 2 months old cutting.....	10.1 ± 0.372	-7.8 ± 0.986	significant
Plants from 3 months old cutting.....	8.2 ± 0.379	-1.9 ± 0.531	significant
Plants from 4 months old cutting.....	6.7 ± 0.335	-1.5 ± 0.505	slight

Straw production

	YIELD	DIFFERENCE	SIGNIFICANCE OF DIFFERENCE
	grams	grams	
Plants from seed.....	19.1 ± 0.942		
Plants from 2 months old cutting.....	11.8 ± 0.670	-7.3 ± 1.155	significant
Plants from 3 months old cutting.....	10.7 ± 0.518	-1.1 ± 0.846	slight
Plants from 4 months old cutting.....	11.7 ± 0.712	1.0 ± 0.883	insignificant

SUGAR CANE BREEDING IN THE COLLEGE OF AGRICULTURE V: ISOLATION OF LIVE CANE ARROWS AND THEIR USE FOR HYBRIDIZATION¹

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WITH TWO TEXT FIGURES

Much of the success in hybridization work depends on the technique used. This is especially true with sugar cane plants. Realizing this truth, cane breeders in different countries have tried to improve the methods used in cane hybridization. In this College, for instance, we have tried to train cane stalks so that their flowers may be handled conveniently without the operator's using a platform on which to stand to reach the inflorescence. In India Venkatraman (1926)² successfully isolated live arrows by potting cane stalks in earthen pots. In the present experiment attempts were made to use bamboo pots as bamboo is cheap and easily obtained in almost every part of the Philippines. This work in potting cane stalks was carried further in other respects than Venkatraman reported.

This experiment was conducted in the Plant Breeding garden, College of Agriculture, Los Baños, during the 1926-1927 and 1927-1928 sugar cane flowering seasons. The work would have been finished in the 1926-1927 season, had it not been for the typhoon that occurred in November, 1926 which destroyed nearly all the cultures. Only a part of the observations was taken that year. The report was completed in the 1927-1928 season.

The objects of this experiment were: (a) To find out whether or not cane stalks can be isolated from the mother plant by rooting them in bamboo tubes for use in hybridization operations; (b) to find out the effect of potting upon the production of seeds.

MATERIALS AND METHODS *Sugar cane varieties used*

Two types of sugar cane varieties were used in this study; namely, the thick soft and the thin hard types. The thick soft type was represented by varieties, Badila, H-109, New Guinea 24 B, Cebu Purple, Louisiana Striped, 2727 POJ, Mauritius Malagache, D. I. 52, Yellow Caledonia,

¹ Experiment Station contribution No. 585. Prepared in the Department of Agronomy under the direction of Dr. N. B. Mendiola. Received for publication September 13, 1928.

² Venkatraman, T. S. and R. Thomas. 1926. Sugarcane-breeding technique—Isolation of live arrows from undesirable pollen through artificial rooting of canes. The Agricultural Journal of India 21: 203-209.

Caledonia Ribbon, Red Tanna, Black Tanna, Striped Tanna, C. A. 12735, C. A. 15723, P. B. 117, P. B. 119, P. B. 148, P. B. 149, and other promising seedling canes bred at the College. Of the thin hard type, Hind's Special, Toledo, C. A. 12797, C. A. 14797, Chinois, and C. A. C. 87, were tried.

Potting materials

Large-sized bamboo stalks with an outside diameter of about 13 cm. were selected. The stalks were cut into sections about 30 cm. long and containing an internode. Each section forms a bamboo pot. Each bamboo pot was cut into halves lengthwise and a half of circular hole large enough to admit a cane stalk (see fig. 1) was made in the joint of each half. For

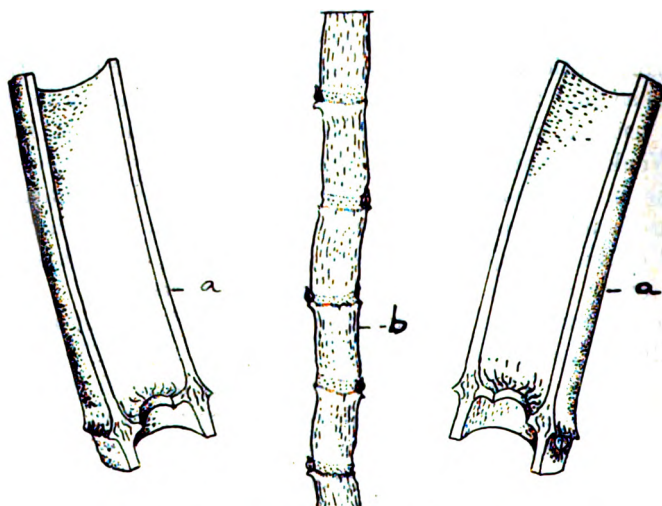


Fig. 1.—*a* Two bamboo halves showing the hole made at the joint; *b* and a lower portion of a cane stalk convenient for potting.

tying the two halves of a pot together wire No. 18 or No. 22 was used as this size is easily tightened with a pair of pliers. Abaca bracts or strong vines can be used instead of wire. When the pots used were small, a second potting was made. Empty petroleum cans, boxes, or similar containers were used for repotting. If a can was used one end was removed and holes made in the other end for drainage. Ordinary garden soil or the soil at the base of the cane plant was used for potting.

Potting

Potting was begun as soon as the cane stalks showed signs of arrowing. Healthy stalks were selected in the field and labeled. Standing stalks were preferred. Recumbent stalks were supported with poles so that the pots

would be either in a slanting or an upright position. The bamboo pots previously prepared were taken to the field and each half was partly filled with soil. Then the two halves were brought close to a stalk to be potted



Fig. 2.—a. Two bamboo halves each filled with soil and placed near the cane stalk for potting; b. a man preparing pieces of wire for tying; c. another man tying the two bamboo halves tightly.

and closed around it. The halves were then tied together with wire and the pot tied to another stalk of the same stool or to a pole. The process of potting is shown in figure 2. The potted stalk was supported by a pole to prevent its lodging. Enough additional soil was put in the pot to cover

two to three nodes of the stalk and pressed a little around it. The stalk was watered immediately after potting. To encourage the early development of roots the soil in the pot was kept moist. The upper portion of the stalk about 30 cm. below the last green leaf sheath was potted.

When the potted stalk had produced abundant roots and the inflorescence could be seen at the top of the topmost leaf sheath, the stalk was cut off just below the pot. The severed stalk was taken to a shed for observation. When repotting was desired the wire was untied from around the pot and the bamboo halves were removed carefully from the rooted portion without loosening the soil. The stalk was then placed in an empty petroleum box or can which was carefully filled with soil which was pressed down to keep the stalk in position. Great care was taken to keep the stalk from turning as this would loosen the soil clinging to the roots and they might be injured. A strong pole was stuck near the can and the stalk was tied to it. When long stalks were potted two or more poles were used for support.

The same process of potting was used with all the varieties used in the two types of canes. In the first year of the experiment it was found that the thin type of cane did not produce roots readily; their development was rather late and slow. By the time the thick soft type had produced an abundance of roots the thin hard type had sent out only a few roots. This observation led to the seeking of other methods of potting the thin type. One method tried was to plant cane points of C. A. C. 87 variety in boxes 33 by 26 by 26 cm. and place them in the cane field. Another method tried was to pot the selected stalks of same variety about a month or more before flowering commenced. Early potting was done to give more time for the stalk to develop roots.

Observations

After potting, observations were made. The time from potting to the time when roots were abundant was noted. Under the shade after cutting, the wilting of leaves and the protrusion of the arrows were observed daily. Other points noted were the opening of the flowers, the dehiscence of anthers, and the production of seeds and seedlings. The ripe seeds of the potted stalks were collected and taken to the laboratory. Several arrows of untreated stalks were collected to serve as control. Seeds of potted and unpotted arrows were grown separately and the number of seedlings produced was counted.

Checkerboard system of planting

In this experiment a checkerboard planting was made in several plots for comparison. Fifteen varieties were planted. Each pair of thick soft and thin hard varieties was planted in alternate rows. The cuttings were planted at a distance of 75 cm. each way. The plot was given uniform treatment during the progress of the work. Observation on the date of

flowering of the different varieties was made. After the first crop was harvested, the varieties were ratooned. At the age of four months the ratoon stalks of the different varieties were counted.

TABLE 1
Age of plants potted and number of seedlings produced

VARIETY NAME	DATE POTTED	DATE CANE WAS CUT	TIME FROM POTTING TO CUTTING	TREATMENT AFTER CUTTING	SEEDLINGS OBTAINED
	1927	1927	days		
C. A. 12735.....	October 22	November 4	13	Repotted	None
C. A. 12735.....	October 22	November 5	14	Repotted	7
C. A. 12735.....	October 22	November 6	15	Repotted	27
C. A. 12735.....	Control	Control	—	—	100
P. B. 270.....	October 22	November 8	17	Repotted	640
P. B. 270.....	October 22	November 2	11	Repotted	618
H-109.....	October 13	November 3	21	—	1
H-109.....	October 13	November 3	21	—	3
H-109.....	October 13	November 3	21	—	32
H-109.....	Control	Control	—	—	911
H-109.....	Control	Control	—	—	170
H-109.....	Control	Control	—	—	558
New Guinea 24B...	October 22	November 8	17	Repotted	5
New Guinea 24B (bagged).....	Control	Control	—	—	None
New Guinea 24B (bagged).....	Control	Control	—	—	3
New Guinea 24B (bagged).....	Control	Control	—	—	7
P. B. 202.....	October 12	November 4	23	—	135
P. B. 219.....	October 12	November 4	23	—	540
P. B. 219.....	October 12	November 4	23	Repotted	682
P. B. 197.....	October 22	November 6	15	Repotted	340
P. B. 197.....	October 22	November 6	15	Repotted	None
P. B. 208.....	October 22	November 6	15	Repotted	16
P. B. 176.....	October 12	November 3	22	—	682
P. B. 185.....	October 12	November 6	25	—	306

RESULTS

The results of the present experiment are presented in tables 1 and 2.

Table 1 gives the number of days from first potting to severing of stalks from the mother plant and the number of seedlings obtained from the potted stalks and from the control.

Table 2 gives the tillering habits of the thick soft and thin hard types of sugar cane.

DISCUSSION OF RESULTS

The belief that not all cane varieties flower and not all varieties that flower can be used for crossing was confirmed during the progress of this experiment. Flowers of some cane varieties are self or cross fertile. Flowers of Yellow Caledonia, Red Tanna, Striped Tanna, Black Tanna,

and Caledonia Ribbon produced neither pollen nor stigma. 213 POJ produced very few pollen grains but the stigmas opened normally. When the flowers of Chinois and Uba opened, the stigmas were normal, but the pollen grains were very few in number. Negros Purple opened its flowers very late and produced pollen very sparsely. As to whether these few pollen grains were viable or not, the writer did not take time to investigate for although they might be viable there was less chance of cross pollination with them than with the varieties well supplied with pollen when used as "fathers". D. I. 52 and Toledo reached the booting stage only and their flowers did not come out at all.

TABLE 2

Tillering habits of two distinct types of sugar cane under checkerboard system of planting

Thick soft type

VARIETY NAME	HILLS ORIGINALLY PLANTED	HILLS CUT TO FIRST RATOON	TOTAL NUMBER OF STALKS AF- TER FIRST RATOON	AVERAGE NUMBER OF STALKS PER STOOL	CONDITION OF THE PLANT
H-109.....	25	21	127	6	No disease
Goru.....	25	20	42	2	1 stalk attacked by Fiji disease
B-247.....	25	18	81	5	21 stalks attacked by Fiji disease
P. B. 119.....	25	10	37	4	2 stalks attacked by mosaic
P. B. 117.....	25	12	40	3	5 stalks attacked by mosaic and 7 attacked by Fiji disease
P. Purple.....	—	27	175	6	42 stalks attacked by Fiji disease
C. Purple.....	25	12	89	7	39 stalks attacked by Fiji disease
Badila.....	24	18	91	5	7 stalks attacked by Fiji disease
Luzon White...	—	30	136	5	5 stalks attacked by Fiji disease
Average number of stalks.....				5	

Thin hard type

Chinois.....	25	25	447	18	No disease
Toledo.....	35	31	329	11	No disease
C. A. C. 87....	30	29	506	17	No disease
Japanese Cane..	5	5	59	12	No disease
Uba.....	—	3	66	22	No disease
Hind's Special..	—	4	55	14	No disease
Average number of stalks.....				16	

Potting and potting materials. Potting was found to be an easy method of rooting sugar cane stalks. The abundance of bamboo plants in the

Philippines made it possible to prepare bamboo pots at a very low cost. Stalks that had small or developing roots when potted sent out roots earlier than those that did not have any at all. The age of the stalk was found to have something to do with the formation of roots. Young stalks did not send out roots as readily as the old ones. They usually did not flower. The lower portion of the stalk sent out roots earlier than the top portion.

Potting the thick soft type. The thick soft type behaved differently from the thin hard one. The roots of this type developed faster and earlier than the thin hard type. In less than three weeks the stalks produced abundant roots in the pot.

Potting the thin hard type. It is very interesting to note that this type of cane sent out its roots later than the thick soft type. In most potted stalks few roots were found three weeks after potting. Three weeks old stalks of potted thin hard type wilted although they were placed under a breeding shed and given good care. It was found necessary to pot this type a month or more before flowering began. The cuttings planted directly in pots developed more than three stalks while the stalks potted before flowering had only one stalk to a pot. Cane points planted in a box tillered similarly to those planted in the field. Repotting was found necessary if the bamboo pots were small or when the severed stalks were intended for ratooning.

Care and treatment of the potted arrows. The development of the potted arrows depended upon the care and treatment given to the newly cut stalks. If the arrows of the potted stalks protruded gradually the flowers opened normally, the anthers, dehisced, and fuzz matured.

Seeds of the potted or repotted stalks grew as well as those of the unpotted ones (see table 1). The production of seeds depended upon the care of the cut stalks. If the potted stalks were neglected, they wilted and ultimately died, hence no seed was produced. The results showed that if a potted or repotted stalk of a fertile variety was well cared for, it produced many seedlings. P. B. 219 which was potted and repotted gave 682 seedlings to the arrow. The potted arrow of P. B. 176 gave nearly 700 seedlings.

Checkerboard planting of canes. The checkerboard system of planting different varieties of sugar cane was found an aid in cross pollination. In the first generation, with the plant canes, all the varieties planted grew very well, and the arrowing stalks usually flowered. However at the first and second ratoons there was varietal struggle for existence. The thin hard type was more resistant to disease and hardier than the thick soft type. As the thin hard type shaded the thick soft type the latter lost its ability to tiller freely and became slender, sickly, and later on died.

As may be seen in table 2, the two distinct types when planted side by side vary greatly in their tillering habits. H-109, New Guinea 24B, B-247, P. B. 117, P. B. 119, Pampanga Purple, Cebu Purple, Badila, and Luzon

White represented the thick soft type. The number of tillers ranged from two to seven stalks to the hill. New Guinea 24B produced an average of two stalks to the hill; P. B. 117, 3 stalks; P. B. 119, 4 stalks; B-247, Badila, and Luzon White, 5 stalks each; H-109 and Pampanga Purple, 6 stalks each; and Cebu Purple, 7 stalks. The nine varieties of soft thick type gave an average of 5 stalks to the hill.

Of the thin hard type, Chinois, Toledo, C. A. C. 87, Japanese Cane, Uba, and Hind's Special were planted. The average number of the stalks to the hill ranged from 11 to 22. Toledo yielded 11 stalks to the hill; Japanese Cane, 12 stalks; Hind's Special, 14 stalks; C. A. C. 87, 17 stalks; Chinois, 18 stalks; and Uba, 22 stalks. The six varieties of the thin hard type gave an average of 16 stalks to the hill which is more than three times the average of the number of stalks to the hill of the thick soft type.

SUMMARY AND CONCLUSIONS

1. It was found necessary to have some knowledge about which varieties flower and which do not and the flowering habits and flower characteristics of the different varieties before potting was done.

2. Potting a stalk could be done on a portion of a stalk either 30 cm. above the ground or just above the surface. A pollen-sterile variety should be potted purposely as "mother" while a pollen-fertile one should be potted preferably as "father".

3. The thick soft type of canes which was potted three or four weeks before flowering sent out roots earlier than the thin hard type. The thick hard type had abundant roots three weeks after potting and the thin hard one a month or so after. The production of roots of the thin type was slow. To grow normally, the potted stalks needed good care.

4. By the use of potted plants for crossing, bagging can be dispensed with and the plants are kept free from undesirable pollen.

5. The normal potted plants flowered, their anthers dehisced, and seeds matured at the same time as with canes growing in the field.

6. Sugar cane stalks rooted very easily. Rooting is a good substitute for the checkerboard system of planting. In the checkerboard planting there was a varietal struggle for existence in the first and subsequent ratoons. Besides, all varieties planted by this method do not flower at the same time, hence it is not always advisable. Isolated stalks can be taken to any convenient place for pollination and are easily protected from destruction by animals. Rooting of canes would be a good method for studying the asexual inheritance of sugar cane.

RECOMMENDATION

The writer recommends the following precautions in potting, if one desires to be successful.

Knowledge as to which varieties flower and which do not is very important for a cane breeder before he attempts to pot canes. Otherwise,

his work is hit-or-miss and much time, labor, and expense is wasted. Before potting, a plant breeder should also know the habits and characteristics of the cane flowers that he may avoid potting stalks that can not be used for pollination work.

The potting materials should be prepared before potting. Select healthy and disease-free sugar cane stalks that have a clear indication of flowering. Stalks from a disease infected stool although they appear healthy should not be potted. To facilitate the potting operation two men should work together.

In repotting one should be very careful not to injure the newly developed roots. Repotting should be done in the breeding shed, for it would be difficult to carry the heavy pots from one place to another.

The success of potting depends principally upon the method and the care and treatment of the potted stalks. The transpiration of the cut stalks should be reduced. Unless good care is given to the plant no seeds will be obtained. On the other hand, if the potted stalks function normally, the production of seeds is not hindered. If the arrows are found growing, the stalks can be used for breeding operation.

THE EFFECTS OF DRY HEAT ON WEEVILS IN CORN AND ON CORN SEEDS¹

ENRIQUE M. PALLER

WITH TWO TEXT FIGURES

INTRODUCTION

Corn grains when attacked by weevils, either in the field or storage, become useless for seed and food purposes. One of the most serious problems in the storage of corn is the control of weevils. Many substances, such as carbon bisulphide, cyanide gas, and copper carbonate dust have been used to kill these harmful insects but the application of heat has not been widely used.

It is important to know the lethal temperatures for weevils in corn when using dry heat for their control and also its effect on the viability, vitality, and productivity of corn. This knowledge will determine how far dry heat may be used in protecting corn grain in storage and in mills from weevils.

Review of literature

There are a number of workers who have investigated the use of dry heat for the control of weevils in cereals and stored grains. Also several investigators have worked on the effect of dry heat on the viability of cereal seeds.

According to Dean (1911) the French long ago knew the value of heat in the control of insects attacking stored grains. They devised "insect mills" which they used in heating the infested grain. He reports that Prof. F. H. Chittenden states in his paper on "Insects Injurious to Grains" that prior to the adoption of carbon disulphide as a fumigant, heat was relied upon in the destruction of insects attacking grains in storage. Dean found in his investigation that weevils are killed when subjected to a temperature of from 105°F. (40.6°C.) to 120°F. (48.9°C.) for from four to five hours a day for several days. He believes that the eggs of mill insects perish before the larvae stage and that a temperature of 115°F. (46.0°C.) for twelve hours proves fatal to the insects in their various stages. For example, 118°F. (47.8°C.) is fatal to the adults of *Calandra oryzae* Linn. and 122°F. (50.0°C.) in eleven minutes is fatal to all stages of *Tribolium confusum* Duv. According to this authority, the larvae, pupae, and adults

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of *Silvanus surinamensis* Linn., *Ephestia kuehniella* Zell, and *Tenebrioides mauritanicus* Linn. are killed when subjected to 120°F. (48.9°C.) for three minutes.

Shafer (1911) in his comment on the article of Dean on "Heat as a Means of Controlling Mill Insects", states that one of the best methods of fixing insects is by heat. He maintains that the parts of an insect can be fixed more quickly by heat, perhaps, than by any other method that has yet been found. When the tissues of an insect are fixed all the way through, it dies.

Goodwin (1922) expresses the belief that larvae, pupae, and adults of insects infesting cereals vary in the intensity of heat required to kill them. He states that a much higher temperature is required to destroy the larva, pupa, and adult than is required for the eggs. His reports show that weevils in chestnut, corn, and ash are killed when subjected to 120 to 125°F. (48.9 to 51.7°C.) for from two to three hours. A temperature of from 130 to 140°F. (54.4 to 60.0°C.) for four days or more will destroy practically all stages of cereal insects. Goodwin (1912) maintains that heat treatment is the most thorough method for the control of insects infesting flour mills. He claims that one treatment a year can completely rid the mill of insect pests and that it is not dangerous to human life, as are the fumigants.

According to Herrick (1914), if a temperature of 130°F. (54.4°C.) is maintained for several hours in a storeroom, the weevils in all the stages of life will be killed. Gossard (1911) reports that in the Kansas Agricultural Experiment Station, 118°F. (47.8°C.) was found to destroy the adults of rice weevil, *Calandra oryzae*. All stages of the saw-toothed grain beetle are killed at 119°F. (48.3°C.). Cadelle beetles perish if subjected to 120°F. for three minutes.

The Ohio Agricultural Experiment Station conducted a test on the different merits of various fumigants and heat for the control of granary and mill insect pests. The results of this test led to the recommendation of installing a heating system in mills.

Graham (1924), reports that temperature determines the rate of development, distribution, and in many cases, the percentage of mortality of *Ips pini* Say, *Monohamus scutellatus* Say, and *Chrysobothris dentipes* Germar. He found that the maximum death temperature of both the larva and adults of *Monohamus scutellatus* is 50°C.; *Ips pini*, 50°C. for the adult and 49°C. for the larva; and for the adult of *Chrysobothris dentipes*, 52°C. According to Doane (1924), 18°F. (-7.8°C.) for four minutes is fatal to all stages of Mediterranean flour moth. He reports that 181°F. (82.9°C.) proved detrimental to all stages of bran beetle, *Echocerus cornutus* Fab. Larson and Fisher (1924) state that during a heavy period of emergence, a temperature of 100°F. (37.8°C.) caused the weevils to leave the bag of seeds soon after emerging.

Dean (1911) reports that wheat can be subjected to a temperature of 150°F. (65.6°C.) for a short time without destroying its germinating power. Goodwin (1922) found that wheat heated at 150°F. (65.6°C.) for two hours germinated as well as the untreated seed. He said that corn subjected to a temperature of 140°F. (60.0°C.) for two days germinated as well as the untreated lot. It was found in the Ohio Agricultural Experiment Station that wheat can be heated at 150°F. (65.6°C.) for eight hours without injuring its germinating qualities.

Larson (1924) expresses the belief that when bean seeds are attacked by weevils, *Bruchus obtectus* Say and *B. quadrimaculatus* Fabr., there follows: (a) Destruction of germination; (b) acceleration of decomposition of seeds during germination; (c) prevention of development of primary leaves; (d) removal and making unavailable much of the plant food.

The experimental tests of Hinds and Turner (1911) show that the injury by weevils affects vitally the percentage of germination of corn seed. The badly infested seeds gave zero per cent germination. These authors report that corn badly infested with weevils is almost worthless, since hogs, horses, and mules will not eat it. They further report that weevil injury is responsible, to a considerable extent, for the irregular stand and lack of uniformity in normal growth in badly infested fields. They maintain that in the United States the injury caused by *Calandra oryzae* seems to be one of the factors which has restricted the raising of corn and the production of live stock and has tended to promote the one crop system of cotton culture.

Goodwin (1922) expresses the belief that the attacks of insects on stored cereals causes them to become insanitary as food, and this is responsible for mill owners having large financial losses.

Rosefeld (1911) states that in Louisiana during 1908 and 1909, *Calandra oryzae* was one of the commonest insects injurious to food stuff. Weevils are reported by various authorities to be one of the most destructive insect pests in stored grains in United States, Java, India, and in the Philippines.

Objects of the present work

The objects of the present work were: (a) To determine the effect of dry heat on weevils in corn; (b) to determine the lethal temperature for weevils attacking corn grains; (c) to determine the effect of dry heat on the viability, vitality, and productivity of corn; and to determine to what extent dry heat can be used in the control of weevils in stored corn.

Time and place of the present work

The work was carried on in the College of Agriculture, from June 1924 to March 1926, a period of one year and nine months.

MATERIALS AND METHODS

Materials

The following materials were used in the present work: (a) Weevil infested corn seeds; (b) good seeds of Calauan Yellow Flint, Moro, Mexican June, Ferguson, Australian Yellow Dent, Baluga, Cebu, Los Baños Yellow Dent, Cagayan Yellow Flint, Diquet, sweet corn, and pop corn; (c) heating apparatus consisting of one box, one oven, two table lamps and two thermometers. (See figure 1.)

Procedure

Determination of the lethal temperature for weevils in corn. Weevil infested corn grains were heated inside the box. Two ordinary table lamps were used in heating the oven. The weevil-infested corn grains were gradually heated to 45°C., 50°C., 55°C., 60°C., 65°C., and 70°C. These temperatures once reached, were kept constant for different periods of time.

The weevil-infested corn was subjected to different temperatures for different periods of time as follows:

1. Heated to 45° C. for 15 minutes.
2. Heated to 50° C. for 15 minutes.
3. Heated to 55° C. for 15 minutes.
4. Heated to 60° C. for 15 minutes.
5. Heated to 65° C. for 15 minutes.
6. Heated to 70° C. for 15 minutes.

Three lots for each of these six temperatures were exposed for 30, 45, and 60 minutes. The period of exposure to heat was adjusted to determine as nearly as possible the length of time necessary to heat the weevils in each lethal temperature. Ten trials were made in each treatment to determine the lethal temperatures for the weevils.

The heating and observation. The weevil-infested corn grains were put in ordinary cigar boxes 22.9 cm.×15.8 cm.×7 cm. and then heated. The same amount of weevil-infested corn grains was used in each treatment throughout the experiment. The weevils were taken from the oven at the end of the time of exposure to heat. When the weevils appeared dead, the heated weevil-infested corn was allowed to cool and then was put in well-corked bottles for observation during one year. This procedure was to determine whether or not the larva and pupa were killed and to be sure that the adults were dead.

Regulation and control of heat. Since it is difficult to maintain a constant temperature in the oven used, the writer devised a simple heating apparatus (see fig. 1). It consisted of a box 73 cm. long, 46 cm. wide, and 48 cm. thick. The box had four openings. One, the door, was large enough to admit the oven and was closed by a board which could be easily removed. Above the door was the window, 12 cm.×5.5 cm. This was closed by a

piece of cardboard which could be opened and closed. Below the door was another opening, 32.5 cm. $\times$ 6.5 cm. which was never closed. This opening was for the draft of air and for making the adjustment of the wicks of the lamps easy. At the top of the box was another window, 31 $\times$ 3 cm. covered by a board which could be closed and opened. This heating apparatus lessened to a great extent the variation of temperature in the oven and thus

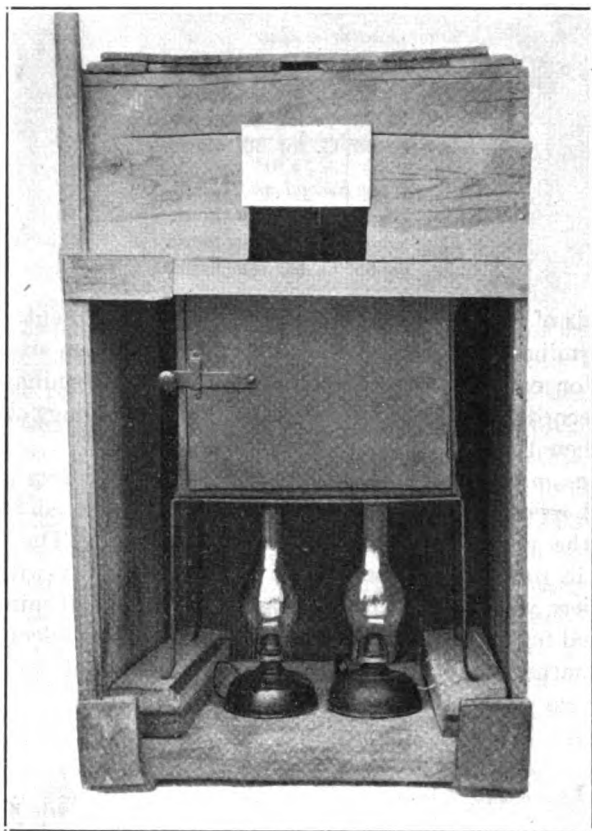


Fig. 1.—Heating apparatus, open, showing the oven and lamps. Note the thermometer through the window.

made the control of temperature more efficient. The writer found that constant temperature could be maintained for several hours in this apparatus.

The heat or temperature was regulated and controlled through the adjustment of the wick of the lamps. When the oven was over-heated, the temperature was lowered by opening the windows and the door and turning down the wick of the lamps. The wick of the lamps could be adjusted easily through the opening at the lower side of the front of the box.

Two thermometers were inserted at the top of the oven. The reading of these thermometers could be easily taken through the window. The valves of the thermometers were placed near the weevil-infested corn in the oven.

Determination of the effect of dry heat on the viability and vitality of corn seeds. Good seeds of the varieties Calauan Yellow Flint, Moro, Mexican June, Ferguson, Australian Yellow Dent, Baluga, Cebu, Los Baños Yellow Dent, Cagayan Yellow Flint, Diquet, sweet corn, and pop corn were heated as follows:

First set

1. To 45° C. for 30 minutes.
2. To 55° C. for 30 minutes.
3. To 65° C. for 30 minutes.

Second set

1. To 45° C. for one hour.
2. To 55° C. for one hour.
3. To 65° C. for one hour.

Fifty seeds of each variety were used for each treatment. The treated seeds were germinated in uniform soil in boxes of uniform size. There was one control for each variety. The percentage of germination for each variety was recorded. The average dry weight of seedlings of each variety was taken when they were one week old.

Determination of the effect of dry heat on the productivity of corn. Five hundred good seeds of Calauan Yellow Flint were heated in two sets as given under the viability and vitality determination. The treated seeds were planted in rows at the distance of 75 cm. each way with three seeds to a hill. There was one control for seeds heated for 30 minutes and one for seeds heated for one hour. One hundred plants were selected at random from every treatment and from the control. The height, weight of straw, and weight of ear of the 100 plants were taken at maturity.

RESULTS AND DISCUSSION

The lethal temperatures for weevils in corn seed.

Table 1 shows that of the weevils in corn seeds, rice weevil, *Calandra oryzae*, granary weevil, *Calandra granaria*, and the confused flour-beetle *Tribolium confusum* perished when heated gradually to 50°C. for 45 minutes, 55°C. for 20 minutes, 60°C. for 10 minutes, and less than a minute at 65°C.² Not only the adults but also the larvae and pupae perished at these lethal temperatures. The heated weevil-infested corn seeds with the dead weevils

²For description of these weevils see:

Back, E. A., and R. T. Cotton, 1922. Stored grain pests. U. S. Dept. Agric. Farmers' Bull. 1260: 2-47;

Forbes, Stephen A. 1912. Noxious and beneficial insects in the State of Illinois. Twenty-seventh report of the State Entomologist of Illinois. 1-43: 52 fig.

Herrick, Glenn W. 1914. Insects injurious to household and annoying to man. xvii + 470 p., 160 fig. New York: The Macmillan Company.

were allowed to cool and were then put in well-corked bottles for observation. The one-year observation revealed that not a single weevil survived or developed. No living insect was observed.

TABLE 1
*Showing the lethal temperatures for Calandra
oryzae, Calandra granaria, and Tribolium
confusum in corn*

NUMBER	LETHAL TEMPERATURES	
	Temperature	Time of exposure to heat
1	50° C.	45 minutes
2	55° C.	20 minutes
3	60° C.	10 minutes
4	65° C.	Less than 1 minute

The weevils subjected to the temperature of 45°C. for six hours, 50°C. for 40 minutes, 55°C. for 15 minutes, and 60°C. for 5 minutes became very weak and some of the adults and larvae appeared to be dead. The corn infested with these weevils was put in well-corked exhibition bottles and treated in the same manner as that subjected to the lethal temperature. This was done to determine whether or not the condition in the bottles was favorable for the recovery of the weevils. At the end of one week, the adults became active and living larvae were found in the bottles. At the end of the second, third, fourth, fifth, and sixth months, many active adults and living larvae were found in each bottle. Ten trials were made in each treatment and observations showed that the weevils were able to recover.

The weevils when subjected to the lethal temperatures did not recover, but when they were subjected to the same temperatures, but with shorter time of exposure, the weevils were able to recover. This leads to the conclusion that the weevils perished when subjected to the lethal temperatures. Table 1 shows that the length of exposure in the lethal temperatures decreases as the temperature becomes higher.

The weevils tend to come out from their hiding places when the corn is heated. Both the adults and the larvae become more and more uneasy (move here and there) as the temperature and length of exposure to heat increase. This uneasiness continues until they become exhausted and die from the effects of the heat.

The effect of dry heat on the viability and vitality of corn seed

The viability and vitality of corn seed were not affected when it was heated to the temperatures that killed the weevils. The study of tables 2 and 3 leads to the conclusion that the viability and vitality of the seeds of Calauan Yellow Flint, Moro, Mexican June, Ferguson, Australian Yellow

Dent, Baluga, Cebu, Los Baños Yellow Dent, Cagayan Yellow Flint, Diquet, sweet corn, and pop corn, were not affected when heated to 45°C., 55°C. and 65°C. for 30 minutes or for one hour.

TABLE 2
Showing the effect of dry heat on the germination of corn

VARIETIES OF CORN	TREATMENT						
	Exposed for 30 minutes			Exposed for one hour			Control
	45°C.	55°C.	65°C.	45°C.	55°C.	65°C.	
	Germination			Germination			Germination
	per cent	per cent	per cent	per cent	per cent	per cent	per cent
Calauan Yellow Flint.....	100	100	100	100	100	100	100
Moro.....	100	100	100	100	100	100	100
Mexican June.....	100	100	100	100	100	100	100
Ferguson.....	100	100	100	100	100	100	100
Cebu.....	100	100	100	100	100	100	100
Baluga.....	100	100	100	100	100	100	100
Gagayan Yellow Flint.....	100	100	100	100	100	100	100
Los Baños Yellow Dent.....	100	98	100	100	94	100	100
Australian Yellow Dent.....	80	82	80	78	82	80	80
Diquet.....	90	92	88	88	90	92	90
Sweet Corn.....	80	82	82	80	80	82	82
Pop Corn.....	82	80	82	80	78	82	80

TABLE 3
Showing weight of seedlings of corn treated with dry heat

VARIETIES OF CORN	TREATMENT						
	Exposed for 30 minutes			Exposed for one hour			Control
	45°C.	55°C.	65°C.	45°C.	55°C.	65°C.	
	Average weight of seedling			Average weight of seedling			Average weight of seedling
	grams	grams	grams	grams	grams	grams	grams
Calauan Yellow Flint.....	.0890	.0880	.0870	.0900	.0870	.0940	.0920
Moro.....	.0870	.0843	.0843	.0831	.0820	.0831	.0811
Mexican June.....	.0900	.0860	.0880	.0800	.0801	.0840	.0830
Ferguson.....	.0923	.0939	.0923	.0900	.0940	.0923	.0939
Australian Yellow Dent.....	.0834	.0842	.0846	.0623	.0809	.0834	.0823
Cebu.....	.0858	.0849	.0808	.0882	.0880	.0865	.0832
Baluga.....	.0910	.0880	.0963	.0901	.0992	.0905	.0928
Los Baños Yellow Dent.....	.0963	.0981	.0974	.0904	.0921	.0933	.0919
Cagayan Yellow Flint.....	.0863	.0807	.0854	.0880	.0828	.0834	.0834
Diquet.....	.0822	.0802	.0801	.0881	.0844	.0863	.0834
Sweet Corn.....	.0712	.0729	.0720	.0735	.0720	.0738	.0738
Pop Corn.....	.0623	.0625	.0636	.0626	.0601	.0636	.0625

Table 2 shows that the percentage of germination of the treated and the untreated seeds was about the same. The temperatures 45°C., 55°C., and 65°C. for 30 minutes and for one hour did not affect the germinating power of the corn seeds. The percentage of germination of Calauan Yellow Flint, Moro, Mexican June, Ferguson, Cebu, Cagayan Yellow Flint, and Baluga was 100 per cent in both the treated and the untreated seeds. The Diquet and the pop corn when heated to 65°C. for one hour had a germination 2 per cent higher than the control. Under this same treatment, the Australian Yellow Dent, Los Baños Yellow Dent, and sweet corn gave the same percentage of germination as the untreated. When heated to 65°C. for one hour, Los Baños Yellow Dent gave a germination 6 per cent higher than when heated to 55°C. for the same length of time. Under the same treatment Diquet and sweet corn gave 2 per cent higher germination and pop corn 4 per cent higher. Observation revealed that the treated seeds germinated as uniformly as the control. The seeds from the treated and from the untreated seeds gave practically the same stand.

Table 3 shows that the average weight of seedlings of Calauan Yellow Flint, Moro, Mexican June, Ferguson, Australian Yellow Dent, Baluga, Cebu, Los Baños Yellow Dent, Cagayan Yellow Flint, Diquet, sweet corn, and pop corn was not affected when heated to 45°C., 55°C., and 65°C. for 30 minutes and for one hour. This result indicates that the corn plant was not affected by the heat treatment given, in so far as the weight of the seedling was concerned. The Ferguson variety when heated to 65°C. for one hour gave a higher average weight of seedling than the control. When heated to 45°C., and 65°C. for 30 minutes and to 45°C. and 65°C. for one hour it gave a lower average weight of seedling than the control. Seeds heated to 55°C. and 65°C. for one hour gave a higher average weight of seedling than the seeds heated to 45°C. for the same period of time.

When heated to 45°C., 55°C., and 65°C. for 30 minutes and to 65°C. for one hour, Mexican June variety gave a higher average weight of seedling than the control. With the same variety, seeds heated to 45°C. and 55°C. for one hour gave a lower average weight of seedling than the untreated seeds. The seeds heated to 65°C. for 30 minutes gave a higher average weight of seedling than those heated to 55°C. for the same period of time. The seeds heated to 65°C. for one hour gave a higher average weight of seedling than the seeds heated to 45°C. and 55°C. for the same length of time.

The sweet corn when heated to 65°C. for one hour gave seedlings of same average weight as the untreated seeds. The seeds when heated to 45°C., 55°C., and 65°C. for 30 minutes and to 45°C. and 55°C. for one hour gave a lower average weight of seedling than the untreated seeds. The seeds heated to 55°C. for 30 minutes and to 45°C. and 65°C. for one hour gave a higher average weight of seedling than the seeds heated to 45°C. and 65°C. for 30 minutes and to 55°C. for one hour.

When heated to 65°C. for 30 minutes and to 45°C. and 65°C. for one hour, the pop corn seed produced a higher average weight of seedling than the untreated seeds did. When heated to 45°C. for 30 minutes and to 55°C. for one hour, the average weight of seedling was lower than from the untreated seeds. The seeds heated to 55°C. for 30 minutes and the untreated seeds had the same average weight of seedling. The seeds heated to 65°C. for 30 minutes and to 65°C. for one hour produced a higher average weight of seedling than those heated to 45°C. for 30 minutes and to 55°C. for one hour.

When the seeds of Calauan Yellow Flint corn were heated to 65°C. for one hour, the average weight of seedling was higher than with the untreated seeds. The seeds heated to 45°C., 55°C., and 65°C. for 30 minutes and to 45°C. and 55°C. for one hour gave a lower average weight of seedling than the untreated seeds did. The seeds heated to 45°C. and 65°C. for one hour gave a higher average weight of seedling than the seeds heated to 45°C., 55°C., and 65°C. for 30 minutes and to 55°C. for one hour.

The same effect on the average weight of seedlings was true of Australian Yellow Dent, Diquet, Cebu, Los Baños Yellow Flint, Moro, and Baluga. All these data show that the heat treatment given the seed did not affect its viability and vitality.

Effect of dry heat on the productivity of corn

It is evident from table 4 that the temperatures and exposures fatal to corn weevils do not affect the productivity of corn. The production of neither the wet nor the dry season planting was affected when the seeds were heated to 45°C., 55°C., and 65°C. for 30 minutes and for one hour. It was found under this treatment that the seeds of Calauan Yellow Flint produced plants as vigorous and productive as the untreated seeds in both the wet and dry season plantings. For, while actual differences were registered in the average height of plants, and in the average weight of straw and of ear of the heated and untreated seeds, these differences were of no practical significance (see table 4).

Actual observations in the field showed that the plants in the treated and untreated rows were similar. The general appearance and color of the plants from the treated and untreated seeds in the wet and dry season plantings were observed to be similar. In dry season planting where the corn grew well, the plants from both the treated and untreated seeds were vigorous and tall. The plants in the wet season planting were not so good as in the dry season, but the plants from the treated and untreated seeds behaved similarly. This shows that the corn was not affected by the heat treatment given.

TABLE 4
Showing the effect of dry heat on the productivity of Calauan Yellow Flint corn

TREATMENT		WET SEASON PLANTING			DRY SEASON PLANTING		
Temperature	Length of exposure to heat	Average height of plant	Average weight of ear	Average weight of straw	Average height of plant	Average weight of ear	Average weight of straw
	min.	cm.	grams	grams	cm.	grams	grams
45° C.	30	153.9 ± 1.1507	34.25 ± 0.9025	25.04 ± 0.6218	222.9 ± 1.3854	100.66 ± 1.9337	91.340
55° C.	30	150.91 ± 0.8296	33.65 ± 1.0745	25.41 ± 0.5267	222.88 ± 1.6660	94.90 ± 2.0673	97.099
65° C.	30	153.98 ± 1.0617	38.95 ± 1.0165	26.17 ± 0.5274	223.48 ± 0.9821	94.065 ± 2.4012	96.935
Control		153.14 ± 1.2006	37.84 ± 1.0509	28.88 ± 0.6576	227.39 ± 1.2289	100.066 ± 1.7611	92.944
45° C.	60	153.81 ± 1.0873	38.89 ± 1.1345	33.30 ± 0.8363	231.32 ± 1.5291	97.00 ± 1.7883	90.999
55° C.	60	153.07 ± 1.2343	34.84 ± 1.2095	26.87 ± 0.4376	219.87 ± 1.0972	99.47 ± 1.8731	99.530
65° C.	60	157.8 ± 1.2343	37.98 ± 1.0792	26.73 ± 0.5978	221.52 ± 1.0522	101.139 ± 2.1201	93.861
Control		149.64 ± 0.9956	34.13 ± 1.1305	26.75 ± 0.5605	210.80 ± 0.9322	99.56 ± 1.2779	94.630

SUMMARY OF CONCLUSIONS

1. The lethal temperatures for weevils *Calandra oryzae* Linn., *Calandra granaria*, and *Tribolium confusum* Duv. which attack corn grains are:

- (a) 50°C. for 45 minutes.
- (b) 55°C. for 20 minutes.
- (c) 60°C. for 10 minutes.
- (d) When heated at 65°C. for even less than 1 minute.

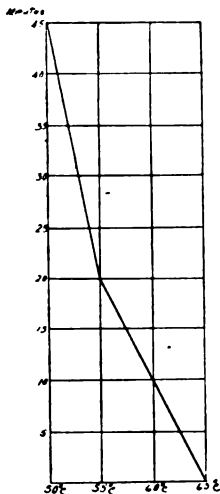


Fig. 2.—Showing the lethal temperatures for weevils in corn seed.

2. At these lethal temperatures the larvae, pupae, and adults of *Calandra oryzae*, *Calandra granaria*, and *Tribolium confusum* perish.
3. The viability and vitality of the seeds of Calauan Yellow Flint, Moro, Mexican June, Ferguson, Australian Yellow Dent, Cagayan Yellow Flint, Baluga, Cebu, Los Baños Yellow Dent, Diquet, sweet corn, and pop corn were not affected when heated to 45°C., 55°C., and 65°C. for 30 minutes or for one hour.
4. The productivity of Calauan Yellow Flint corn was not affected when heated to 45°C., 55°C., and 65°C. for 30 minutes or for one hour.
5. Corn grains can be heated 65°C. for one hour without injury.
6. Corn seeds can be heated (dry heat) to a temperature sufficient to kill weevils attacking them without affecting their viability, vitality, or production.
7. Dry heat can be safely used as a means to control weevils attacking corn in storage and in mills.

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A REVIEW: "COMMERCIAL TIMBER TREES OF THE MALAY PENINSULA"¹

This publication should be of great value to tropical forestry. The identification of forest trees in the tropics is still quite a problem because of the numerous species with slight differences. But the author of this book seems to have discovered a feasible or practical remedy for this difficulty. His key to the identification of Malayan trees, based on bark characteristics, is well worthy of study with the object of adapting it to Philippine species.

In the first part of the book, the author gives the methods used and after describing the territory, the climate and the population, he discusses in a general way the forests of the Malay Peninsula. He groups them into three classes, namely: littoral forest, lowland forest, and hill forest. The most important of these is the lowland forest which extends from just behind the littoral forest to an elevation of about 2,000 feet. This forest is composed of several storeys. The first, or top storey is made up of very large trees, mostly of the family Dipterocarpaceae, whose crowns start at 60 to 100 feet or more above the ground. Like in the Philippine forests, the big volume of trees is in the family Dipterocarpaceae which constitute about 60 per cent of the stand. Next comes the family Leguminosae furnishing about 10.5 per cent of the volume of the timber produced. There are known so far about 2,500 species of trees in the forests of the peninsula.

The second part, or the greater portion of the book, deals at length with the principal commercial timber trees, giving the botanical descriptions of each; its silvicultural characteristics and economic value. Many of these trees are identical with those found in the Philippine Islands, and their growth habits will serve as an invaluable basis for comparison in our growth studies. The illustrations in the book are excellent. The growth data were taken from various sample plots established within the past 25 years by the Malayan Forest Department. The plots contain over 10,000 trees, representing more than 30 species.

Doctor Foxworthy, author of the publication, should be congratulated for having published such a valuable contribution to tropical forestry.

ADRIANO V. SANTOS
Of the Philippine Bureau of Forestry

¹ Foxworthy, F. W. 1927. Commercial timber trees of the Malay Peninsula. 195 p., 136 fig. and 1 map. Malayan Forest Records No. 3, Federated Malay States Government.

ABSTRACT¹

Variability in important agronomical characters among seedling canes from parent varieties H-227, Louisiana Striped, Cebu Purple, and Badila. VICENTE T. FLORIDA (*Thesis presented for graduation, 1926, from the College of Agriculture No. 281; Experiment Station contribution No. 587*).—This work covered a period of about two years, from November 1924 to March 1926. True seeds were obtained from parent varieties Louisiana Striped, H-227, Cebu Purple, and Badila. These seeds were germinated in Standard Oil petroleum boxes in which was sterilized soil to a depth of about ten centimeters. The seedlings were transplanted to nursery plots when they were about 35 to 40 centimeters high. The space between plants was 75 by 50 centimeters. The plants numbered 1133. At the age of about a year these plants were harvested. The vegetative offspring and seedlings of these plants were again planted.

The important agronomical characters studied were total solids, height, and diameter of the main stalk of each stool, and the total number of millable stalks in each stool.

The results were discussed as follows:

The young seedlings of the different varieties used, although of the same age, showed great variation in the percentage of total solids.

About the same range of variability in the height of main stalks was found in the 1924 Louisiana Striped seedlings, in the 1925 P. B.² offspring; also in the 1925 P. B. asexual offspring and the H-227 1925 seedlings. The 1925 Cebu Purple seedlings manifested the widest range of variability.

The Louisiana Striped 1924 seedlings and Cebu Purple 1925 seedlings had about the same range of variation in the diameter of stalk. The same was true with the H-227 seedlings, H-227 P. B. asexual offspring, H-227 1925 seedlings, and Badila 1925 seedlings.

In the range of variability of millable stalks, a standard deviation of 11.033 ± 0.075 was obtained from the 1925 Louisiana Striped P. B. asexual offspring and only 1.778 ± 0.379 from the 1924 Louisiana Striped seedlings. There was no significant range of variability in the other seedlings. The H-227 1925 seedlings showed the greatest range of variability in the number of unmillable stalks.

The comparison made between the agronomical characters of the 1924 Louisiana Striped seedlings and the 1925 Louisiana Striped P. B. asexual offspring was as follows:

¹ Abstract prepared as part of the required work in English 6, College of Agriculture.

² Numbers with the "P. B." prefix indicate seedlings which have been selected for at least one time.

The percentage of total solids of the 1925 Louisiana Striped asexual offspring was 25.58 ± 0.098 and that of the 1924 Louisiana Striped seedlings was 16.78 ± 0.159 . The difference between these two which is 5.80 ± 0.187 is significant and shows the effect of selection. The 1925 Louisiana P. B. offspring had a mean of 23.89 ± 0.019 and the 1924 Louisiana Striped seedlings, 15.80 ± 0.051 per cent. This result shows a significant difference and again it indicates the effect of selection.

The average weight of main stalks in the 1924 Louisiana Striped seedlings was 4.03 ± 0.027 kilograms and that of 1926 Louisiana P. B. asexual offspring was 1.96 ± 0.047 kilograms. Selection for this character was effective.

Selection for height of main stalk seemed to be effective only in the case of Louisiana Striped and for number of millable stalks in the case of H-227.

The selected individuals after the study of the seedlings raised in 1925 was finished are:

Two individuals, P. B. 151 and P. B. 152, were selected from among 284 Louisiana Striped seedlings; two, P. B. 153 and P. B. 154, from among 170 H-227 seedlings; three, P. B. 155, P. B. 156, and P. B. 157 from among 57 Badila seedlings; and three, P. B. 158, P. B. 159, and P. B. 160, from among 58 Cebu Purple seedlings.

—Abstract by José O. Cruz.

EXCHANGE NOTES

A simple test for determining rices that will prevent beriberi in human beings and polyneuritis in pigeons and other fowls has been developed by Dr. Edward B. Vedder, of the U. S. Army Medical Corps, stationed at Manila, and R. T. Feliciano, chemist of the Manila Bureau of Science. The rice grains are stained with an iodine solution, the starch granules taking on a blue color. The proportion of external layers, which remain unstained, and which contain the beriberi-preventing factor, may be determined with reasonable accuracy by simple inspection, report these investigators. This method is so quick that it may be used during the milling process to determine the degree of milling. A chemical index for beriberi-preventing rice was also determined.

—Science.

The agricultural college at the University of Illinois has assumed leadership in many ways, particularly in its farm management studies. It is now studying the difficult problem of agricultural readjustments, and could profitably undertake a study of the more extensive commercial use of farm products as raw materials for industry.

—The Prairie Farmer (Illinois).

Rice field day was held Colusa County, California, September 14.

Blackbirds are so numerous over the rice fields of Butte County that the sky is occasionally darkened and control of their numbers is eagerly sought.

Jesse Perkins, Evansville, Oregon, has a chicken with one head, two bodies and four legs. Its actions are those of a normal fowl.

—*California Cultivator.*

The influence of the high per capita registration of automobiles in the United States is evidenced in the fact that, whereas in the world as a whole there is one automobile to each 64 persons, when the cars and people in the United States are not taken into consideration, this ratio becomes one automobile to 277 persons.

The extremes of popular reception of automotive transportation are found in the United States, where the ratio is one car to each small group of 5 people, and in Ethiopia, where the presence of only 109 automobiles and about 10,000,000 inhabitants makes the ratio as one to 91,743.

The number of persons per automobile in nearby countries are as follows: United States, 5.1; India, 3,333; Japan, 1,525; Malaya, British, 113; Philippine Islands, 407; China, 21,062, Siam, 1,460; and Borneo, Dutch, 953.

—*Commerce Reports (U. S. A.)*

It is essential that human diet has bulk as well as food value. A diet consisting entirely of proteins and starches leads to constipation, but when a bulk or 'roughage' of cellulose is present, digestion proceeds on its normal course. A breakfast food manufactured from milled rice had a very low cellulose content, and thus was not an ideal food. The deficiency has been overcome by the introduction of a pure edible cellulose made from the hull of the rice. It is prepared by cooking the hull with strong caustic soda solution followed by a hydration treatment to reduce it to a physical form suitable for use as an edible material. In the final state it is a light, fine, mealy, material. It is odourless and tasteless, and has a mealy feel in the mouth. Analysis of the finally purified product shows it to be practically pure cellulose.

Tests on its dietary value have been carried out on various subjects. In all cases the cellulose added to the milled rice obviated the ill effects of a diet of pure milled rice. It is suggested that the cellulose content of other foods be augmented by the addition of this edible rice cellulose.

—*Tropical Agriculture.*

In keeping with the progress which has been made from year to year, the provisions for the Eighth Annual American Poultry Congress, to be held October 1 to 7 at Waterloo, Iowa, insures this stellar event of a ranking

as one of the preeminent expositions of America. The Poultry Congress will be held as in previous years, in connection with the Dairy Cattle Congress and the National Belgian Horse Show, thus insuring breeders of exhibiting their birds before more than 100,000 of the best farmers of the Middlewest.

—*California Cultivator.*

The valuable work of the Illinois agricultural college and experiment station is well illustrated by the many excellent articles from members of the staff which have appeared in PRAIRIE FARMER during the past few months. We have published these articles in the hope of helping to bring the information which they contained into more general use. Agriculture as organized at present is highly competitive. The man who succeeds is the one who most quickly learns improved methods and puts them into use.

—*The Prairie Farmer* (Illinois).

COLLEGE AND ALUMNI NOTES

Mr. Tei Ishii, assistant entomologist of the Agricultural Experiment Station, Nishigahara, Japan, is working in the entomological laboratory of this College. He expects to spend about three months here. Mr. Ishii has been on an entomological tour of the rice-growing countries of the orient in search of natural enemies of one of the rice-stem borers, *Chilo simplex* Butler, which is a serious pest in Japan.

The Secretary reports 25 new registrants for the second semester. The total enrollment for the College year, 1928-29 is 881.

The Los Baños Biological Club held its thirty-ninth scientific program in the Auditorium of the College of Agriculture on November 22, 1928.

The following papers were read and discussed:

"The cost of milk production at the College of Agriculture."

By Mr. Felix B. Sarao.

"Three methods of vitalizing the teaching of Philippine crops."

By Mr. Zósimo T. Montemayor.

"The trend of sexual and reproductive seasons among horses, cattle, water buffaloes, sheep and goats under Los Baños Conditions.—A preliminary report."

By Dr. Valente Villegas.

Among the articles of interest in the Forest School quarterly, *The Makiling Echo* issued in January are: "Forest Labor in the Philippines" by Forester, Carlos Sulit, and "Kaiñgin Problem in the Philippines" by O. W. Pflueger, Chief, Division of Investigation.

Mrs. V. R. Aborn of Whittier, California, a former student of Dean Baker's in Pomona College writes Professor Yule that she was invited a few weeks ago to speak before "The Journal Club" whose members are biology majors at Whittier College and took for her subject Dean Baker's work, especially in entomology. Mrs. Aborn further writes that at a recent banquet at Pomona College Dr. A. R. Davis, associate professor of plant pathology of the University of California in his talk said that the three men who most influenced him in his student days were Professor Baker, Doctor Cook, and Professor Bracket. Mrs. Aborn inclosed (unsolicited) a generous contribution to the Baker Memorial Fund.

The Mimics second play of the year was presented the evening of December 5. The production was "The Twelfth Commandment" by George St. Clair, formerly head of the Department of English, College of Liberal Arts, U. P., "Thou Shall Not Gamble" the twelfth commandment gives the key note of the play.

The Cast were:

Nena—Juan's wife.....	Concepción Estavillo
Anita—his sister.....	Máxima Mulimbayan
Sing—his cook.....	José Austria
Carlos—his brother-in-law.....	Domingo Regner
Juan—A well-to-do-planter.....	Onapre Casupang
Marina—his friend.....	Gerónimo Pascua
Santos } friends of Marina.....	(Valentin Amon
Cruz }	(Vicente Fernandez
Pedro—Juan's servant.....	Sabas Tangco
A Bill Collector.....	Ruperto Ami
A Policeman.....	Miguel de Guzman

The presentation revealed competent work on the part of the Director, Miss Anne Cole and careful study and rehearsal on the part of the cast, which had been carefully selected. Each interpreted his part well, remarkably well, considering that it was the "premier" appearance of most of the cast. The character with few lines acted his part with the same care in interpretation as the major characters. Hence there were no weak parts. The director and each member of the cast merit warm commendation for their sincere efforts, as do the other members of the Mimics for their efficient assistance.

By request this play was repeated January 12.

AGRICULTURAL EDUCATION IN THE UNITED STATES

According to *The Journal of the Ministry of Agriculture*, London, agricultural education in the United States of America during the past thirteen years has made remarkable progress through the development of the extension movement. This development dates from the introduction of the Smith-Lever Act in 1914, the keynote of which is co-operation. Prior to this Act, colleges were conducting considerable extension work with their own funds, and the Federal Department of Agriculture was spending, independently of the colleges, a further sum of 1,000,000 dollars. This work is now carried out by a single division, organized at the college, with a director at its head, appointed by the college with the assent of the Secretary of Agriculture. There is further co-operation between colleges in part of the extension work and in the plan for the voluntary pooling of all funds available for the various States.

In 1914 the State and Federal Governments were spending 1,600,000 dollars on extension work in agriculture and home economics, and, by 1924, this figure had increased to 19,394,639 dollars per annum, of which approximately 12,000,000 dollars were contributed by the States and counties.

In the same period, the total personnel increased from 1,230 to 4,764 officers, the latter figure including 765 full-time specialists, extension directors, and other supervisory officers.

In determining the policy of the extension work for a district, the farmers, with the agents of the co-operating county, State and Federal Governments, together review the local conditions and agree upon what ought to be done. The administration of the work is then entrusted to the State College of Agriculture. The full recognition of local people, conditions and practices, and the enlistment of the active participation of the individual farmer and his family in the planning and the carrying out of local extension work, are the two fundamental considerations to which the success is accredited. Demonstration farms are owned and operated by the farmers under schemes developed jointly by the farmers and the Government agents. This partnership of the farmer with the Government, together with his work as a voluntary helper in the capacity of demonstrator, chairman or member of committee, has developed a sense of rural leadership, and given to the farmer a greater breadth of outlook, apart from the more direct benefit which accrues from the opportunity of improving his technical efficiency. The primary object of extension work, however, is

the adoption of an improved practice, and there is evidence of a much wider use by farmers of lime, cover crops, green manures, fertilisers, seed of improved and standardised varieties, and of the improvement of orchards by renovation, pruning, and spraying.

Farmers are advised as to the formation of co-operative organisations for the disposal of their products and for the purchasing of their supplies, provided with general information on marketing problems, encouraged to adopt better business principles, and stimulated to keep and utilise farm records as a means of regulating their business.

—*Agricultural Journal*, (Queensland).

In China men-who-work-with-their-hands-at-dawn, to use the analysis of the character "agriculture," are regarded as being of the utmost importance, ranking next only to scholars in the social scale; and nowhere can their well-tried methods be better studied than on either shore of the Great River. Beyond reed banks, stretch fertile fields, where blue-coated men and women tend their crops literally "throughout the period of the sun's light." At dawn the first objects to be clearly distinguished, are human figures in the fields, weeding, weeding, weeding; and when yellow dusk turns to darkness those same figures melt away, still weeding, weeding, weeding.—FLORENCE Ayscough, In *A Chinese Mirror*.

There are seven mistakes of life that many of us make," said a famous writer, and then he gave the following list:

The delusion that individual advancement is made by crushing others down.

The tendency to worry about things that cannot be changed or corrected.

Insisting that a thing is impossible because we ourselves cannot accomplish it.

Refusing to set aside trivial preference in order that important things may be accomplished.

Neglecting development and refinement of the mind by not acquiring the habit of reading.

Attempting to compel other people to believe and live as we do.

The failure to establish the habit of saving money.—*The Aberdeen-Angus Journal*.

THE NAGOYA, A NEW IMMIGRANT FROM JAPAN¹

F. M. FRONDA AND B. M. GONZALEZ
Of the Department of Animal Husbandry

WITH THREE TEXT FIGURES

The "Nagoya," a dual purpose fowl, was recently introduced into the College of Agriculture at Los Baños from Japan where this breed of fowls



Fig. 1.—A male Nagoya. This is one of the four roosters raised from the eggs brought from Japan in 1926.

makes up a large portion of that Empire's poultry population. When the junior author, Dean Gonzalez, returned in 1926 from Tokyo, where as a delegate he had attended the Pan-Pacific Scientific Congress, he brought

¹Experiment Station Contribution No. 588. Received for publication January 8, 1929.

with him eggs of this breed. When this was done we had little idea that something that may help solve the country's call for more eggs and poultry of good quality was being introduced in the College. The chickens hatched from these eggs, fourteen in all, in spite of their being new to our local conditions, performed so well that we do not hesitate to recommend this breed even to beginners in chicken raising.

As the foundation stock of the Nagoya was a cross of Japanese "farm fowls and Shanghais which were imported into Japan from South China in the latter part of the nineteenth century" it is very probable that this breed carries some blood of our popular Cantonese breed.² This bit of history

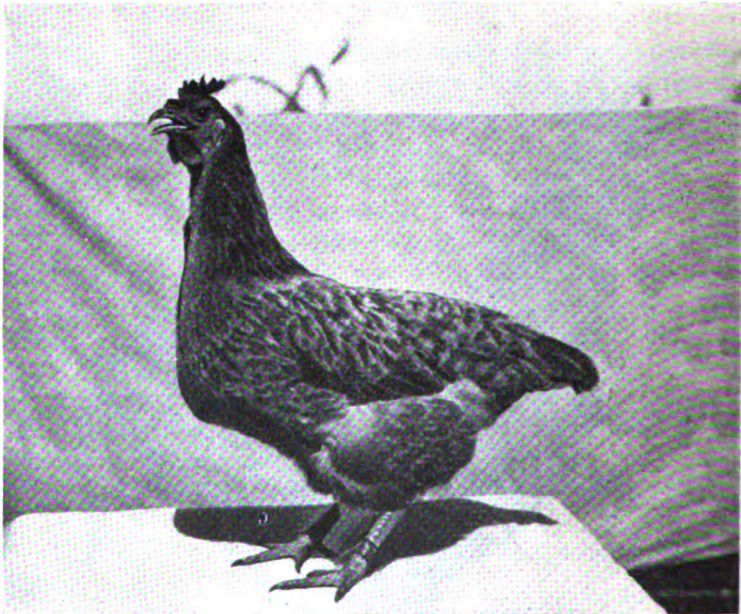


Fig. 2.—A female Nagoya. This is one of the four hens raised from the eggs brought from Japan in 1926.

is important for the reason that as the Cantonese has already proved its worth in the Philippines, being capable of multiplication and improvement under local conditions of environment, we may reasonably expect the same of the Nagoya. The small number of chickens raised in this College during the two years since the Nagoya eggs were brought here indicate that our conclusion is justified; also the layers that are now under observation are performing beyond our modest expectations as to the value of these fowls.

While work in the improvement of the "Los Baños Improved Cantonese" had its early beginnings with a raw and unfinished material, this newly

²Susaki, Shinji. 1927. On "Nagoya" one of dual purpose poultry breeds originated in Japan. Proceedings of World's Poultry Congress (1927): 60-63.

introduced Nagoya breed of fowls is almost a finished product. The eggs are uniformly strong-shelled, large, healthy brown in color, that is, brown with a pinkish tinge, not unlike the Rhode Island Red eggs in both size and color, although the Nagoya eggs are perhaps a little the larger.

The number of Nagoya eggs brought in the introductory settings was thirty. These eggs were laid in Japan from November 11 to 17, 1926, and when weighed in the College on December 1 following, the date when these eggs were placed under hens for incubation, the weights ranged from 53.5 to 72.0 grams each, with an average of 62.0 grams; the weight would have been more had the eggs not been 14 to 20 days old. It may be many years before this size in eggs will be reached with our improved Cantonese, but increase in size of eggs is one of the goals towards which our work aims. In color, the Cantonese eggs now compare very favorably with the Nagoya.



Fig. 3.—The present flock of Nagoya fowls in the College of Agriculture, January, 1929.

Fourteen chicks were hatched out of the original thirty eggs. This hatch was a great deal better than was expected, for the eggs had travelled for about a week across none too smooth seas. The eggs were packed well in rice hulls in a box. Under arrangement with the ship officers these eggs were placed in the vegetable refrigerating room. This courteous co-operation of the officers (*S. S. President Jackson*) helped considerably in the success of the importation as the eggs were placed at a temperature where the development of the embryos was not possible. Under less favorable conditions of transportation, we venture to state that the good hatching result would not have been possible. This experience suggests the possibility of importing eggs of improved breeds of chickens into the Islands rather than the fowls themselves. It would be cheaper, less trouble and would minimize the danger of disease introduction.

The baby Nagoya chicks are much like the Cantonese in color but they are much larger in size. In about two weeks after hatching, the original yellow shanks and beaks turn slate, or bluish in color. As the chicken matures this color becomes pronounced. The skin is white. The mature fowls have feathers with the same Columbian color pattern as the Cantonese, the color of plumage, however, is less uniform and a shade deeper than the rich golden buff of the Cantonese, although it is not as deep red as the Rhode Island Red. In size, the mature individuals compare very favorably with the Rhode Island Reds, although they do not look as heavy because the Nagoyas are rather closely feathered. Because of the close feathering, the Nagoya appears to be more leggy than the Rhode Island Red. The mature male fowl weighs on the average 2.25 kilograms and the female, 1.75 kilograms. The Japanese Standard of Perfection for this breed is 2.5 kilograms (5.5 lbs.) for a cockerel and 1.8 kilograms (4.0 lbs.) for a pullet. The four cocks raised from the thirty eggs average 2.27 kilograms and the four hens average 1.83 kilograms, while the standard requires 3.41 kilograms (7.5 lbs.) for a cock and 2.73 kilograms (6.0 lbs.) for a hen³.

Out of the fourteen chicks hatched, eight were raised to maturity, four males and four females. Of the six that were lost during the brooding period, three were stolen by hawks, and three died of disease caused by intestinal round worms. Considering the fact that the breed was just from a country of much colder climate than ours, this record of the Nagoya may be considered as exceptionally good. The effects of the sudden change of climate from cold to warm was apparently shown in the rate of growth and delayed maturity of the birds. The chicks grew well during their early life, but after several months, when they were out in the open most of the time, the rate of growth slackened considerably. As a result, the four original pullets were rather late in maturing. In Japan, the Nagoya grows very quickly, the pullets maturing when six months old⁴. But under our conditions, the four pullets did not begin to lay until they were almost a year old, the youngest to lay being only a month and seven days short of one year, whereas the oldest to lay was a year and eight days old. These four pullets have just completed their first laying year with a fairly good egg production record, considering that they are recent immigrants. The individual record for the year is 106, 74, 91, and 98 eggs each; records that may be considered very good especially for birds that were hatched from eggs that had had an unusual history.

The Nagoya has one weakness. The majority of our small flock of these fowls, the males particularly, are affected with scaly legs. The other birds in the College flocks, although as heavy as the Nagoyas, are not as susceptible to this leg trouble. However, this should not be considered as a serious drawback, as scaly leg can be easily controlled with the regular application of vaseline or a mixture of coconut oil and kerosene. Pure

^{3, 4} *loc. cit.*

kerosene may be used, but the result is not so satisfactory as the mixture with oil. Waste oil from automobiles and other machines may be used to a great advantage in the control of these parasites.

The principal points in favor of the Nagoya breed may be enumerated as follows:

a. The fowls are strong, hardy and seem to adapt themselves to local environmental conditions.

b. They are fairly large-sized, and they lay a fair average of large eggs with uniformly brown shells.

c. The plumage color is fairly even; and the body type is uniform.

The Japanese standard for this breed contains, among other things, the following points:⁶ The comb is single, and the tail is medium in size. The beak is stout and the body is long, broad, deep, and full. The wings are medium in size, the upper half web of the primaries is reddish buff, lower half, black; secondaries upper half web, black, lower half, buff; primary coverts, black. In the male, the sickles and main tail feathers are black with greenish lustre; the tail coverts, black, changing to buff as they near the saddle. The rest of the body feathers are buff. The shanks and toes are lead colored, and feathered shanks are a disqualification.

⁶ *loc. cit.*

COMPARATIVE ANALYSES OF AMERICAN AND PHILIPPINE CIGARETTES¹

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It is well known that the quality of tobacco depends upon many factors, the most important being the climate, the soil in which the plant is grown, the fertilizer used, the variety of the plant grown, the method of culture, the stage at which the leaves are picked, and the method of curing followed. The chemical changes that take place in the production of other crops such as corn or rice, may be as complex as those that take place in the production of the tobacco leaf, but with no crop is the taste of the consumer so critical as with tobacco. Certain definite qualities in tobacco, such as its burning quality, toughness, pliability, color and aroma, must satisfy the consumer, otherwise the product is not marketable.

The aim of the present work was to find the differences in composition between the cigarettes of American manufacture and those made in the Philippines, with the object of determining whether the desirable qualities of the American cigarettes can be imparted to Philippine tobacco leaves.

REVIEW OF THE LITERATURE

The changes that take place in the curing of tobacco are known, at least in a general way. Thus, according to Behrens (1895), the following changes take place during the drying of tobacco: (a) the dry weight decreases; (b) the salts of organic acids increase; (c) the nitrogenous substances decrease, although the amids increase and the nicotine content does not change; (d) the ethereal oil evaporates; and (e) the salts of sulfuric acid increase. According to the same authority, the following changes take place in the later stages of curing: (a) the dry weight decreases because of loss in carbohydrates and organic acids; (b) a part of the nicotine disappears; (c) the nitric acid is completely eliminated; (d) asparagin disappears, while amido acids appear; (e) the weight of ether extractable substances is decreased; and (f) a gaseous substance (possibly butyric acid) is formed.

These results are more or less verified by other workers. Thus Garner and Bacon conclude from their experiments that the starch is first transformed into the sugars which in turn are transformed into oxalic, citric, and malic acids and finally decomposed into carbon dioxide and water. The pentosans behave in a similar manner. The protein substances of

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the leaf, however, are changed into the amid and amido derivatives and finally are transformed into ammonia, carbon dioxide, and water.

The relation between the quality of tobacco and its chemical characteristics has been studied by several workers. Among them may be mentioned A. Schmuck and Balabuha-Popzowa (1927) who arrived at the conclusions that: (a) the amount of carbohydrates together with that of polyphenols increases in the samples of tobacco of higher quality; (b) the amount of protein and total nitrogen decreases in the samples of better quality while the nicotine content and the ash content increase in tobacco of inferior quality; (c) the ratio of total carbohydrates to the protein is a good index of the quality of tobacco, the higher ratio indicating tobacco of superior quality; (d) dark colored tobaccos contain a greater amount of nicotine, protein, and total nitrogen, and less carbohydrates and phenols than lighter colored tobaccos, the latter being therefore superior in quality to the former.

Furthermore, the supposition that the greater the carbohydrate content of tobacco the brighter the color has been verified by Schmuck and Semanova (1927). The same investigation showed that tobacco (either green or fermented) contains, besides carbohydrates, fairly large amounts of substances (probably polyphenols) which reduce Fehling's solution. These substances may alter the carbohydrate content of the tobacco, and indicate its aroma, although the absolute content of these phenols show very little relation to the color of the tobacco.

Piatnitzki (1927), working on the chemical composition of the leaves from different pickings, found that the percentages of the total nitrogen, protein nitrogen, nicotine, free organic bases and tobacco resins increase from the lower (first) picking to the upper picking, while the amounts of malic acid, total organic acid and ash decrease from the lower to the upper pickings. He also found that the polyphenol substances, as a rule, increase from the lower to the upper pickings, although in some cases, the maximum content of these substances is found in pickings between the first and last.

De Vries and Sidenius (1916) working on the burning quality of tobacco, studied three factors; namely, the duration of glow, the color of the ash, and the percentage composition of the ash. According to these investigators, the greater the duration of the glow and the whiter the ash, the better is the quality of tobacco. Furthermore, tobacco of superior quality contains less ash (total percentage), and less chlorine and SiO_2 in the ash.

The nature of the aromatic substances in tobacco has been studied by Schmuck (1926) who found that in the benzene extract of tobacco there is a substance, insoluble in petroleum ether, ether and water, which possesses a pleasant weak aromatic odor and which upon burning forms aromatic products having an irritating influence on the mucous membrane; while in the alcohol extract, there is another substance, insoluble in petroleum ether, ether, carbon bisulfide, or water, but soluble in methyl alcohol, which

gives a pleasant smoke when burned, and which reduces Fehling's solution upon heating with HCl.

Graham and Carr² (1924) obtained results somewhat similar to those of Schmuck. They found that the vegetable waxes, volatile oils, and loosely combined nicotine contained in the petroleum ether extract are responsible for much of the irritating effect of the tobacco. They, furthermore, found that although the composition of tobacco may be greatly improved by different fertilizer treatments, the tobaccos which command the best price in the market are those which are grown on relatively poor sandy or clay soil, and which are characterized by a low percentage of the extractives, proteins, and nicotine. These characteristics apply mostly to cigar tobaccos; they found that smoking tobacco is characterized by a high percentage of extractives in petroleum ether, ether, and alcohol. It may be pointed out, in passing, that benzene and petroleum ether extract the vegetable waxes, ethereal oils, phenols, some chlorophyll and some nicotine; ether extracts resins, some glucosides, much nicotine and some chlorophyll; ethyl alcohol extracts sugars, tannins, some resins, and the remaining nicotine; while boiling water extracts acids, mucilage, carbohydrates and albumin.

MATERIALS AND METHODS USED

Ten brands of American-made cigarettes, sixteen of Philippine-made cigarettes and five different varieties of tobacco cured in the Department of Agricultural Chemistry of this College² were used in the analyses. All the American cigarettes were obtained in the local market. The Fatima, Piedmont, Chesterfield, Cycle, and Camel brands are too well known to need description. The Diamond and Rubi brands are manufactured in the Philippines but are made from leaves cured in the United States. The Condax is manufactured by E. A. Condax and Co., Inc. in the United States, the Aztecas by the Golden West Tobacco Co. (of California), and the Benaderets' by S. Benaderet, Inc. of San Francisco, California.

The Philippine brands used are the La Insular, Cagayanes, La Dalaga, La Dicha, Rositas, Lakandula, Mileguas, La Brisa Filipina, Londres (cigars) and Favoritos de J. Santa Marina (cigars). Besides these cigarettes and cigars, three grades of tobacco leaves sent by the Alhambra Cigar and Cigarette Manufacturing Co., were used. According to this company, the first and second grade leaves come from the Isabela region, and the third grade (which is cigarette tobacco) is a mixture of Isabela and Cagayan leaves. The samples of Favoritos de J. Santa Marina (cigars) and La Insular (cigarettes) were sent by the La Insular Cigar and Cigarette Factory, Inc., and are considered by this company to be its best brand; the Londres (cigars) and the La Brisa Filipina (cigarettes) from the same company are its lowest

²The method of curing followed together with the conditions affecting the qualities of the leaves, will form the subject of another article.

priced products. The other Philippine brands were bought in the local market. Besides these brands of manufactured tobacco, six varieties of tobacco grown in Los Baños Municipality and cured and treated in the laboratory of the Department of Agricultural Chemistry of this College were used. H_1 is a hybrid of Improved Gold Leaf and the native tobacco from San Antonio, Los Baños. I_1 is Texas Cuban tobacco introduced in the College in 1914. I_2 is Connecticut Havana tobacco. N_{41} is a variety called *alafug* from Tuao, Cagayan. N_{41} , according to records, is Repollo mixed with Pampano and Espada Bacalao; it was obtained from Naguilian, Isabela. N_{47} , according to the records, is 40-Espada, obtained from the Ilagan Tobacco Experiment Station. Mixture A was a mixture of unidentified tobacco leaves grown and cured in the Department of Agricultural Chemistry of this College. The soil in which these varieties were grown is clay loam—no fertilizer was applied.

The method of analysis used consists in successively extracting the dried powdered tobacco in hot benzene, ether, 95 per cent alcohol and water. Weighed samples were placed in thimbles and each was hung by means of a wire in a 500 cc. Erlenmeyer flask on top of which is a condenser. (The set-up is similar to that for the extraction of oil). Two hundred cubic centimeters of the solvent were allowed to flow slowly from the top of the condenser through the powder. The flask was then heated, taking care that the rate of flow of the drop from the condenser tube to the sample was between one to two drops a second.

Experience had shown that it required about six days (of eight hours a day) of extraction with benzene before subsequent extractions failed to give any residue; two and one-half days were required for ether, and six and one-half days for alcohol to give the same results. These periods of extraction were, therefore, used in the analysis. In the case of water, the time allowed for extraction was only one day, even if the drops coming from the thimble were found to be somewhat colored; for comparative purposes the results obtained seemed to be sufficient. After each extraction the solution was placed in a flask or beaker and evaporated in a steam bath to a solid consistency.

It was noted that in the extraction with benzene and with alcohol a residue was left in the extractor flask. This may be explained by considering that in the method of heating used, no attempt was made to prevent local overheating at the bottom, so that it would be expected that a part of the extractive would be carbonized or decomposed, thus giving the residue observed. This is an important source of error in the determination. Another source of error is in the heating in the steam bath. One hour of heating may change the quantity of extraction by about 0.5 per cent owing to the disappearance of the more volatile constituents. This is why the alcohol extract was not expressed to an accuracy less than one per cent.

In order to discover further differences between American-made and Philippine-made cigarettes, the percentages of ash, protein nitrogen, and total nitrogen were determined according to the Official and Tentative Methods of Analysis of the Association of Official Agricultural Chemists (1920).

DISCUSSION OF RESULTS

Table 1 shows the percentages of the different extracts obtained from American-made cigarettes.

Table 2 shows the percentages of the different extracts obtained from Philippine-made cigarettes and a few cigars.

Table 3 shows the percentages of the different extracts obtained from Philippine cigarettes the tobacco of which was cured in the Department of Agricultural Chemistry.

Steam treatment was applied upon some of the brands with the object of testing whether this treatment would improve the quality of the cigarettes.

Table 4 shows the amount of ash, protein, nitrogen and total nitrogen in the different cigarettes.

Tables 1, 2, and 3 show that the great difference between the Philippine-made cigarettes and those of American manufacture is that the percentages of extractives (except the water extraction) in the American is much higher than the Philippine cigarettes. Thus the average benzene extract for Philippine cigarettes was 7.5 per cent, while that for American cigarettes was 10.8 per cent. The percentages of the benzene extracts for the cheap Philippine cigarettes, such as *La Insular*, *Cagayanes*, *La Dalaga*, *La Dicha*, *Rositas* and *La Brisa Filipina* all lie between 5.6 to 7.4 per cent. The more expensive cigarettes have higher benzene extracts—thus *Lakandula* had 10.6 per cent and *Mileguas* had 9.0 per cent. The cigars, as the *Favoritos de Santa Marina*, *Londres*, and *Isabela 1st* and *Isabela 2nd*, are all characterized by a fairly high benzene extract. The lowest benzene extract among the American cigarettes analyzed was 8.5 per cent (*Aztecas*) and the highest, 12.9 per cent (*Camel*). The cigarettes cured in the College Laboratory had benzene extracts varying from 9.4 to 13.7 per cent. The same varieties (H_1 , I_1 , and I_2 in table 2) when cured in the ordinary way in the barn for one year also yielded high benzene extracts (10.6 to 14.4 per cent).

The effect of steaming on Philippine-made cigarettes varied—in some cases the benzene extract was increased, while in other cases it was decreased. The same is true of cigarettes the tobacco of which was cured in the College Laboratory. In American cigarettes, however, the general tendency is an increase in the benzene extract when the cigarettes are steamed.

A comparison of the ether extracts leads to the conclusion that American cigarettes contain about twice as much ether extractive as the Philippine cigarettes; the cigarettes, the tobacco of which was cured in the College Laboratory yielded ether extracts midway between the two.

It is evident from the comparison of the alcohol extracts that Philippine-made cigarettes have much lower alcohol extracts than American-made cigarettes, the former ranging from 7 to 18 per cent, and the latter from 19 per cent (Aztecas) to 36 per cent (Piedmont). The average for Philippine-made cigarettes is 10 per cent, and for American cigarettes it is 29 per cent, and for Philippine cigarettes of tobacco cured in the College Laboratory, it is 24 per cent. It is doubtful if this difference between the American-made cigarettes (except a few) and those of tobacco cured in the College laboratory can be ascribed solely to the presence of petuning substances in the former, as it appears that the flavor and aroma of most American cigarette leaves are sufficient; no additional flavoring is needed. The high percentage of the alcohol extract in American-made cigarettes and those cured in the College Laboratory is ascribed to the presence of a large quantity of sugars which have resulted from the almost complete decomposition of the starch.

Steaming appears to increase the alcohol extractives in the case of Philippine-made cigarettes and those cured in the College Laboratory, while in the case of American-made cigarettes, the reverse (decrease) is observed. The reason for this may be that in the preparation of the American cigarettes so much steaming had been done that further steaming resulted in the volatilization of the more volatile constituents of the alcohol extract.

It is interesting to note that while the varieties H₁, I₁, and I₂, which were cured in the usual way for one year, and the Lakandula and Favoritos de J. Santa Marina gave high benzene extracts, their ether and alcohol extracts are all comparatively low, showing that the starchy material of the leaf had not been completely reduced to the sugars.

A comparison of the water extract shows that American-made cigarettes have a lower percentage of water extractives than Philippine-made cigarettes, and that the leaves cured in the College Laboratory have water extractives about midway between the two. Only in the constituents of this water extract are the American-made cigarettes apparently deficient. Steaming seems to have the effect of decreasing the percentage of the water extract.

It is possible from the above considerations that an index may be determined whereby one could tell from extraction methods, the suitability of cured tobacco leaves for cigarette purposes. In table 5, the sum of the benzene, ether, and alcohol extracts is termed *A*, the water extract is termed

B, and the values of $\frac{A}{B}$ and $\frac{A}{A+B}$ are calculated.

The values of $\frac{A}{B}$ for the different samples are illuminating, and have a certain similarity to the ratio proposed by Schmuck and Balabuha-Pop-sowa. If we take such brands as the Camel, Fatima, and Chesterfield as

the standards, then a good type of cigarette may be defined as that whose

$\frac{A}{B}$ ratio is not less than 2.0. It may be explained that one reason why some of the American-made cigarettes have high $\frac{A}{B}$ ratios, is that petun-

ing substances are used. It will also be seen from table 5 that Aztecas, which seems to be inferior to the standards mentioned above, has a low

$\frac{A}{B}$ ratio. From the same table, it will be seen that the leaves cured and made into cigarettes in the College Laboratory have $\frac{A}{B}$ ratios varying from

1.3 to 2.1. From smoking observations, the I_7 was classed as similar to Piedmont, while the other varieties gave smoking characteristics somewhat inferior to those of I_7 . All the Philippine-made cigars and cigarettes studied

gave $\frac{A}{B}$ ratios below 1.3, the cigarettes ranging from 0.4 to 0.8 and having an average ratio of 0.6, and the Londres and the Alhambra 1st (cigars) both giving 1.2.

Another index worthy of consideration is the $\frac{A}{A+B}$ ratio. It will be seen from the table that while American-made cigarettes have $\frac{A}{A+B}$ ratios varying from 0.6 to 0.8 (Aztecas has 0.5), and the cigarettes cured in the College Laboratory have ratios varying from 0.5 to 0.7, the Philippine-made cigarettes (and cigars) have ratios varying from 0.3 to 0.5.

Since the percentage of the ether extract is small, the value of the ratio $\frac{A}{A+B}$ will not be changed if the ether extract is not included in

the calculation of A ; furthermore, in the alcohol extraction this will be most nearly dissolved. Three extractions will therefore suffice to

obtain this ratio $\frac{A}{A+B}$; namely, the benzene, alcohol and water extracts.

Finally, table 4 shows the difference in the nitrogen and ash contents of the American-made and Philippine-made cigarettes. It is to be noted that the protein nitrogen, total nitrogen, and ash contents in Philippine-made cigarettes (and cigars) are higher than in either the American-made cigarettes or those cured in our laboratory, the last two groups having approximately the same percentages of these constituents³. Steaming

³ N_{41} has high percentages of protein nitrogen and total nitrogen because it was steamed with ammonia.

appears to have the effect of lowering the nitrogen content of cigarettes. In fact, experience shows that Philippine cigarettes taste better and lack that characteristically bitter taste, when they are steamed for one or two hours and dried before using.

It may be pointed out that in the manufacture of some cigarettes in the Philippines, the stems are generally included, but this would raise the ash content only by about one per cent. Even taking this difference into consideration, it is seen that the ash content of Philippine-made cigarettes is higher than that of American-made cigarettes by about three per cent.

SUMMARY

Comparative analyses of American-made cigarettes, Philippine-made cigarettes, and cigarettes cured in the College Laboratory showed that Philippine-made cigarettes have lower benzene, ether, and alcohol extractives, but higher water extractive than American-made cigarettes; the cigarettes made from tobacco grown in Los Baños and cured in the College Laboratory give extractives about midway between the two. The ash, total nitrogen and protein of Philippine-made cigarettes are also higher than American-made cigarettes or those cured in the College Laboratory.

In some cases the quality of cigarettes cured in the College Laboratory was similar to that of Piedmont, the aroma, color, pliability and burning quality approximating those of many standard American cigarettes.

An index was found whereby it could be determined whether or not a tobacco is good for cigarette purposes.

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TABLE 1
Composition of American-made cigarettes

NAME OF BRAND	EXPER. NO.	TREATMENT	BENZENE EXTRACT	ETHER EXTRACT	ALCOHOL EXTRACT	WATER EXTRACT
			<i>per cent</i>	<i>per cent</i>	<i>per cent</i>	<i>per cent</i>
Fatima.....	1	None.....	10.0	2.0	32	17
Piedmont.....	2	None.....	9.9	2.6	36	14
Chesterfield.....	54	None.....	10.3	—	—	—
Cycle.....	6	None.....	9.4	1.8	26	18
Camel.....	14	None.....	12.9	1.9	24	17
Condax.....	13	None.....	12.7	1.1	25	25
Aztecas.....	15	None.....	8.5	1.9	19	25
Diamond.....	29	None.....	10.4	2.4	34	22
Rubi.....	30	None.....	10.3	2.6	34	15
Benaderet's.....	47	None.....	12.5	2.1	21	17
Fatima.....	44	Steamed 2 hrs.	13.6	2.8	26	10
Piedmont.....	22	Steamed 3 hrs.	—	1.4	30	17
Chesterfield.....	21	Steamed 3 hrs.	15.6	1.9	26	20
Cycle.....	51	Steamed 2 hrs.	10.6	2.2	—	—
Camel.....	59	Steamed 2 hrs.	10.0	0.5	23	14
Diamond.....	57	Steamed 2 hrs.	9.0	—	13	17
Rubi.....	58	Steamed 2 hrs.	9.3	1.7	25	17
Average for the untreated cigarettes.....			10.8	2.1	29	19

TABLE 2
Composition of Philippine-made cigarettes

NAME OF BRAND	EXPER. NO.	TREATMENT	BENZENE EXTRACT	ETHER EXTRACT	ALCOHOL EXTRACT	WATER EXTRACT
			<i>per cent</i>	<i>per cent</i>	<i>per cent</i>	<i>per cent</i>
La Insular.....	3	None.....	6.6	0.4	10	27
Cagayanes.....	4	None.....	5.6	1.4	10	21
La Dalaga.....	7	None.....	5.8	0.2	8	38
La Dicha.....	8	None.....	6.5	0.5	9	36
Rositas.....	16	None.....	7.4	0.5	9	26
Lakandula.....	31	None.....	10.6	0.5	10	40
Mileguas.....	32	None.....	9.0	0.0	8	21
La Brisa Filipina.....	33	None.....	7.2	1.1	(18)?	(13)?
Londres ^a	34	None.....	8.3	1.7	10	17
Favoritas de J. Sta. Marina ^a	35	None.....	10.6	0.8	10	41
Alhambra, 1st.....	37	None.....	10.6	0.2	12	19
Alhambra, 2nd.....	39	None.....	8.8	0.9	7	32
Alhambra, 3rd.....	41	None.....	9.0	0.4	14	22
H ₂ (1927).....	45	Cured in barn for 1 year..	12.9	0.8	15	26
I ₇ (1927).....	46	Cured in barn for 1 year...	10.6	0.4	7	16
I ₉ (1927).....	48	Cured in barn for 1 year...	14.4	0.5	13	25
La Insular.....	52	Steamed 2 hrs.	7.1	0.4	—	—
Cagayanes.....	56	Steamed 2 hrs.	6.8	0.7	—	—
La Dalaga.....	23	Steamed 3 hrs.	6.2	0.0	10	24
La Dicha.....	24	Steamed 3 hrs.	6.9	0.0	11	29
Rositas.....	60	Steamed 2 hrs.	8.1	0.1	8	21
Alhambra, 1st.....	38	Steamed 2 hrs.	10.4	0.0	12	28
Alhambra, 2nd.....	40	Steamed 2 hrs.	8.7	0.8	10	30
Alhambra, 3rd.....	42	Steamed 2 hrs.	8.3	—	—	—
Average for untreated Philippine-made cigarettes...			7.5	0.6	10	27

^aCigars.

TABLE 3

Composition of Philippine tobacco cured in College Laboratory

VARIETY	EXPER. NO.	TREATMENT	BENZENE EXTRACT	ETHER EXTRACT	ALCOHOL EXTRACT	WATER EXTRACT
			<i>per cent</i>	<i>per cent</i>	<i>per cent</i>	<i>per cent</i>
H ₃	12	None.....	9.4	0.9	24	27
M ₃	20	Steamed for 1 hr. at 115° C.....	9.2	2.3	27	18
H ₂	19	Steamed under vacuum for 3 hr. at 72° C.....	9.5	1.7	25	28
I ₇	11	None.....	10.4	1.2	22	16
I ₇	10	Steamed for 2 hours.....	10.2	1.7	27	7
I ₇	9	Heated for 2 hours above 100° C.....	10.2	1.2	23	14
I ₆	17	None.....	9.6	—	20	23
I ₆		Steamed for 1½ hr. at 115° C.....	10.4	2.8	17	37
I ₆	18	Steamed under vacuum for 3 hr. at 72° C.....	9.8	1.1	19	30
N ₃₇	25	Leaves dried above 100° C.....	12.2	(0.1)	27	25
N ₃₇	26	Leaves heated immediately after picking.....	14.4	1.4	25	22
N ₄₅	28	None.....	13.7	0.9	24	23
N ₄₅	27	Steamed for 3 hours.....	14.4	0.6	22	26
N ₄₁	43	Steamed with NH ₃ for 2 hours...	11.1	0.0	24	19
Mixture A.	49	None.....	10.5	1.0	—	—
Mixture A.	53	Steamed for 2 hours.....	11.9	1.6	—	—
Average for the untreated samples.....			10.8	1.0	24	22

TABLE 4

Percentages of protein nitrogen, total nitrogen, and ash in different tobaccos

SAMPLE	TREATMENT	PROTEIN NITROGEN	TOTAL NITROGEN	ASH
		<i>per cent</i>	<i>per cent</i>	<i>per cent</i>
<i>American-made cigarettes</i>				
Diamond.....	None.....	1.96	2.20	15.6
Fatima.....	Steamed 2 hours.....	2.47	3.42	—
Piedmont.....	Steamed 3 hours.....	—	2.93	16.3
Rubi.....	None.....	2.13	2.34	—
<i>Filipino cigarettes cured in College Laboratory</i>				
I ₉	Steamed 3 hours at 72° C.....	2.82	3.14	16.7
I ₉	Steamed 1½ hrs. at 105° C.....	2.75	3.00	17.0
H ₁	Vacuum steam 3 hrs. at 72° C..	—	2.31	—
N ₄	Steamed with NH ₃ 1½ hours at 105° C.....	4.17	4.31	15.1
<i>Filipino-made cigarettes</i>				
La Dalaga.....	Steamed 3 hours.....	—	2.92	—
La Dicha.....	Steamed 3 hours.....	3.02	—	—
La Brisa Filipina.....	None.....	2.76	3.31	19.7
Favoritos de J. Sta. Marina..	None.....	3.82	3.89	20.7
Lakandula.....	None.....	3.76	3.57	19.4
Mileguas.....	None.....	3.17	3.34	21.4
Londres.....	None.....	3.50	3.86	19.4
1st Class (Alhambra).....	None.....	4.30	—	19.0
1st Class (Alhambra).....	Steamed 2 hours.....	4.33	4.45	18.8
2nd Class (Alhambra).....	None.....	2.90	3.07	22.3
2nd Class (Alhambra).....	Steamed 2 hours.....	2.60	3.94	21.1
3rd Class (Alhambra),.....	None.....	3.51	3.93	21.2
3rd Class (Alhambra).....	Steamed 2 hours.....	3.14	3.40	20.8

TABLE 5

Showing indices $\frac{A}{B}$ and $\frac{A}{A+B}$

NAME OF BRAND OR VARIETY	TREAT- MENT	A BENZENE, ETHER AND ALCOHOL EXTRACTS	B WATER EXTRACT	A + B	$\frac{A}{B}$	$\frac{A}{A+B}$
		per cent	per cent	per cent		
<i>American-made</i>						
Fatima	None	44	17	61	2.6	0.7
Piedmont	"	49	14	63	3.5	0.8
Chesterfield	"					
Cycle	"	37	18	55	2.1	0.7
Camel	"	39	17	56	2.3	0.7
Condax	"	39	25	64	1.6	0.6
Aztecas	"	29	25	54	1.2	0.5
Diamond	"	47	22	69	2.1	0.7
Rubi	"	47	15	62	3.1	0.8
Benaderet's	"	36	17	53	2.1	0.7
<i>Cured in the College laboratory</i>						
H ₃	None	34	27	61	1.3	0.6
I ₇	"	33	16	49	2.1	0.7
I ₉	"	30	23	53	1.3	0.6
N ₄₅	"	37	26	53	1.4	0.7
<i>Philippine-made</i>						
La Insular	None	17	27	44	0.6	0.4
Cagayanes	"	17	21	38	0.8	0.4
La Dalaga	"	14	38	52	0.4	0.3
La Dicha	"	16	36	52	0.4	0.3
Rositas	"	17	26	43	0.7	0.4
Lakandula	"	21	40	61	0.5	0.3
Mileguas	"	17	21	38	0.8	0.5
Londres	"	20	17	37	1.2	0.5
Favoritos de J. Sta. Marina ..	"	21	41	62	0.5	0.3
Alhambra, 1st	"	23	19	42	1.2	0.5
Alhambra, 2nd	"	17	32	49	0.5	0.3
Alhambra, 3rd	"	23	22	45	1.0	0.5
H ₃ (cured 1 year)	"	29	26	55	1.1	0.5
I ₇ (cured 1 year)	"	18	16	34	1.1	0.5
I ₉ (cured 1 year)	"	28	25	53	1.1	0.5

A SUMMARY OF STUDIES ON THE DEPTH OF IRRIGATION WATER FOR LOWLAND RICE IN WESTERN LAGUNA¹

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WITH ONE PLATE

It is known that the depth of irrigation water used in the Philippines for any one variety of rice varies in different regions. Also, that variations occur from field to field; that one farmer differs from another in his experience as to the depth of irrigation water necessary to grow his crop. And furthermore it is known that there are different depths for different varieties according to the common practice.

In the College of Agriculture, seven studies were carried in six different years on farms in western Laguna to determine the depth of the irrigation water from the preparation of the field for rice to the harvest of the crop. In these studies, there was no attempt whatever to control the amount of water used. The study is mainly the finding of the actual depth of irrigation water used by the farmers in their fields, which they had found to be a good practice.

The present paper is a presentation of some of the results found in these seven studies.

REVIEW OF PREVIOUS WORK

Robertson (1917) found that 30 days after emergence of the plant was about the best time for beginning submergence. He also found that 6 inches (15.2 centimeters) was about the best depth of submergence. That where no water was held on the land the yield and quality were very poor.

Adams (1920) reported results of his investigation on the effect of the depth of water on the yield of rice in California. In his study, however, the amount of water used was directly controlled by him. His methods were different from those used by Filipino farmers.

¹Experiment Station contribution No. 590.

This paper is in the main a discussion of data presented in a special problem assigned in Agricultural Engineering and in six theses presented for graduation from the College of Agriculture. These theses are: thesis No. 284 by Eusebio A. Bataclan; thesis No. 285 by Cipriano P. Barbon; thesis No. 286 by Leopoldo J. Villanueva; thesis No. 287 by Cipriano B. Cayabyab; all prepared in the Department of Agricultural Engineering, the first three under the direction of Assistant Professor Anastacio L. Teodoro, and the last one under the direction of Assistant Professor Felix D. Maramba. Thesis No. 288 by Constancio T. Medrana; and thesis No. 289 by Hermenigildo G. Protacio were prepared in the Department of Agronomy under the direction of Assistant Professor Mariano B. Raymundo. The titles of these theses appear under "Literature Cited".

Ricafrente (1921) performed an experiment in the College of Agriculture on the effect of varying depth of submergence on the yield of grain of variety Macan Piña in plots. He found that a continuous supply of water 10 centimeters deep was the best when the water was allowed to pass continuously through the paddy throughout the growing period of the rice. He also found that a supply of 20 centimeters deep gave the highest yield both in grain and straw, while a supply 3 centimeters deep gave the lowest yield. Under the conditions of his study, he concluded that if a supply 20 centimeters deep was allowed to flow through the paddy during the growing period the maximum yield in grain to the hill would be obtained.

From 1914 to 1921, studies were undertaken at the Biggs Rice Station, at Biggs, California, on the culture of lowland rice. Jones (1923) reports that a heavy yield was obtained by submerging the land about 6 inches (15.2 centimeters) during the submergence period. Also that the slowly changing water gave a higher average yield than where the water was stagnant. Another finding was that the fluctuation in the depth of submergence was very much better than slowly changing or stagnant water. Jones concluded that for best irrigation practice the field should be irrigated as often as necessary until 30 days after emergence, and then the land should be submerged 6 inches (15.2 centimeters) continuously until the crop is ready to drain for harvest.

MATERIALS AND METHODS

Fields

For the purpose of this paper, the fields used in the studies are lettered. Fields designated with B, as B-1 etc., are fields in Biñang, Laguna. Those designated as Ca are in Calamba, Cn in Calauan, and R in Santa Rosa, Laguna.

Fields were used at different times in the study, and for this paper carry different designations. (See table 1). Investigations on fields B-1 to B-3 were undertaken by Protacio (1928) in the season from July 1926 to January 1927. Investigations on fields Ca-1 and Ca-2 were made by Barbon (1925) during the season from November 1924 to March 1925. Fields Ca-3 and Ca-4 were studied by Español³ during the season from November 1925 to February 1926. Data for fields Cn-1 to Cn-7 were obtained by Bataclan (1924) during the season from May to October 1923. Fields Cn-8 to Cn-13 were studied by Villanueva (1925) from June to November 1924. Data on fields Cn-14 to Cn-16 were obtained by Cayabyab (1928) from August 1927 to February 1928. Studies on fields R-1 to R-3 were

³The relation between the yield of lowland rice and the depth of irrigation water as practiced by two farmers of Calamba, Laguna, Philippine Islands. (A special problem assigned to Filemon E. Español in the Department of Agricultural Engineering under the direction of Assistant Professor Anastacio L. Teodoro, last part of study under Assistant Professor Felix D. Maramba. 1927.)

made by Medrana (1927) during the season from July 1926 to January 1927.

Table 1 gives a description of the kind of soil in each field. The Biñang fields are of clay loam. The Santa Rosa fields are also of the clay loam type. The soil of Calamba fields was not determined in the work undertaken there; it may be presumed, however, that the Calamba soil is of the clay loam type, as it is in a clay loam region. The Calauan soils were found to be of the clay loam type and as a rule rather high in organic matter.

Varieties of rice

In Biñang, the variety of rice used was Inadhika¹. The seedlings were planted in the field at about 15 to 20 centimeters apart. In Santa Rosa, the varieties used were Macan and Nagsalit. Macan was planted in the field about 20 centimeters apart, and Nagsalit about 25 centimeters. The variety used in Calamba is known as Mangasa. When not broadcasted, the seedlings were planted about 25 centimeters apart. Three varieties of rice were used in Calauan: Binicol, Binangbang-puti, and Guinangang. For any variety, the practice in Calauan is to set the plants about 15 to 20 centimeters apart.

Method of irrigation

The check method of flooding is the type of irrigation practiced in these fields. The water is applied intermittently, hence there are periods when the fields are dry during the growth of the crop.

Stagnation of water is seldom used. The farmers apparently prefer the slow flowing water in flooding the checks.

Preparation of the paddies

About five to nine weeks before planting, the fields were prepared. They were flooded and soaked for a day or so before plowing, which was to a depth of about 20 to 25 centimeters. After plowing, the fields were harrowed.

Harrowing was done with the native harrow called *suyod*. The harrowing was first in one direction and then in a cross direction for three or four times. It appears that the farmers determine the number of harrowings needed by the condition of the fields. If the field has quite a number of heavy clods after the third harrowing then a fourth is necessary.

Seed bed and seedlings

As the amount of water used in the preparation of the seed bed and in the treatment of the seeds is negligible, this phase of the rice cultivation is not given in this paper.

¹The variety names given in this paper are the common names in the Tagalog dialect.

Water gauge

The depth of water in the fields was measured by means of a simple water gauge which consists of a reference stake and a guide stake. The reference stake is driven flush to the surface of the field. To locate this stake easily, the guide stake is set by it. The depth of water is obtained by measuring the distance from the top of the reference stake to the surface of the water. A meter stick can be used for this.

These water gauges are set about five meters from the inlet and outlet of each paddy.

DISCUSSION OF RESULTS

Field preparation

Table 2 shows the average depths of water used in the preparation of the fields. It may be seen in this table that in the preparation of the fields the average depth of water was 11.1 centimeters. The deepest application of water was right after plowing; and the fields were all prepared with only three harrowings.

The time it took to prepare the fields varied from five to nine weeks. The actual irrigation of the fields during the preparation varied from 7 to 60 days, as may be seen in table 5. The average number of irrigation days was 44; in other words, the field was under water for 44 days during the preparation. This practice is quite common in the towns under consideration.

Irrigation of crop

The irrigation of the crop is the phase that is the most important. The fields, from the very day the plants were transplanted, were under the influence of water. Table 3 shows the average weekly measurements of the depth of water in each field from transplanting to the harvest of the crop. It will be seen that the average depth of irrigation water varied in the different fields. It will be noted that the maximum average depth of water was in field Cn-3 with the Guinangang variety; and the minimum average depth in field R-1 with the Nagsalit variety. Table 4 shows the maximum and minimum depths of irrigation water and the time it was applied.

From table 5 it may be readily seen that of the seven varieties used, Inadhika had the highest average maximum depth of irrigation water; and Macan the lowest minimum depth.

The averages here presented are not as they should be for the number of individual variety tests are not the same. However, they are a fair criterion. From the data, it may be seen that Binicol and Guinangang are the heaviest users of irrigation water. Named from the lowest minimum average to the highest, the varieties are, Macan, Binanghang-puti, Inadhika, Nagsalit, Mangasa, Guinangang, and Binicol. Naming from the

highest maximum average to the lowest, the varieties are, Inadhika, Binicol, Mangasa, Guinangang, Binangbang-puti, Nagsalit, and Macan.

Table 5 further shows that the fields for Binangbang-puti had an average of 53 irrigation days during preparation; Mangasa had 50; Nagsalit, 48; Binicol, 43; Guinangang, 42; Inadhika, 41; and Macan, 7. Nagsalit had 123 irrigation days from transplanting to harvest; Binicol had 115; Inadhika, 110; Guinangang, 109; Mangasa, 108; Binangbang-puti, 107; and Macan, 102. From these figures it can be found that the average irrigation days during preparation of fields was about 41 days, and during the growth of any variety about 111 days.

Probable irrigation curves

From the data here presented, the writer has worked out some interesting curves which he calls the "probable irrigation curves." (See plate I.)

The curves are generally all three-period curves. The short maturing crops, Macan and Mangasa, are the only two-period curves. Even these, however, show a tendency to the three-period curve, as undoubtedly would have been the case if the crops had matured later.

These curves show that the intermittent method of irrigation is the common practice in these fields. They further show that the heaviest irrigation is towards the maturity of the crop.

From the individual crop curves, the last curve was developed. This curve is the probable curve for any variety of rice.

These curves show that with any of these varieties if irrigation followed the particular curve, or the relative curve, a fair result would be obtained.

Yields

The yield obtained from each field is shown in table 6. From this table it is evident that Binangbang-puti, Nagsalit, Mangasa, and Guinangang are heavy producers in the order named; and Macan, Inadhika, and Binicol, low producers in the order named. The highest yield was that of field Cn-2, Guinangang, with 63.1 cavans; the lowest was from field R-2, Macan, with 17 cavans.

SUMMARY AND CONCLUSIONS

1. The soils of rice fields in Biñang, Calamba, Calauan, and Santa Rosa, Laguna Province are of the clay loam type.
2. The average depth of irrigation water used during the preparation of the fields was 11.1 centimeters.
3. There was an average of 41 days of irrigation during the preparation of the fields. The deepest irrigation during preparation was after plowing.
4. The average time for maturing of crop was from 12 to 13 weeks for the short-maturing varieties; and 16 to 17 weeks for the long-maturing.

5. The average depth of irrigation water used for each variety was: Binangbang-puti, 6.2 centimeters; Binicol, 12.3; Guinangang, 10.1; Inadhika, 9.3; Macan, 2.9; Mangasa, 9.0; Nagsalit, 2.6. The average depth was 7.5 centimeters.

6. The average yields by variety were: Binangbang-puti, 58.2 cavans; Nagsalit, 56.0; Mangasa, 50.9; Guinangang, 49.5; Binicol, 40.9; Inadhika, 33.9; Macan, 17.0.

7. The probable irrigation curves for each variety are good guides for the irrigation of the crop.

8. The probable irrigation curve for any variety is a guide which may give a fair result for any crop irrigated according to it.

9. Studies should be carried on for some time to get the best irrigation curves.

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TABLE 1

Showing area and kind of soil of each field

FIELDS AND OPERATORS ^b	AREA	KIND OF SOIL ^a	
		Surface layer, 0 to 30 cm.	Sub-surface layer, 30 cm. and below
	<i>Ha.</i>		
B-1..... Dikes Carlit	4.3374	Dark grayish brown, light silty clay loam.	Dark brownish gray silty clay loam.
B-2..... Anacleto Tana	4.0498	Dark gray clay loam mottled with brown specks.	Dark grayish brown clay loam, with large amount of tuff fragments.
B-3..... Benedicto Casaysayan	2.3596	Dark gray mottled silty clay loam.	Silty clay loam, mottled gray and brown.
Ca-1..... Felix Cahanap	1.399	(No determination).	(No determination).
Ca-2..... Francisco Manalo	1.508	(No determination).	(No determination).
Ca-3.....		(Same field as Ca-1).	(Same field as Ca-1).
Ca-4.....		(Same field as Ca-2).	(Same field as Ca-2).
Cn-1..... Francisco Carreon	1.0498	Deep chocolate brown (as a moist hand sample), clay loam.	Dark gray to nearly black, somewhat mottled, (as a moist hand sample); medium heavy clay loam.
Cn-2..... Francisco Carreon	0.9602	Deep chocolate brown (as a moist hand sample).	Gray to nearly black. Clay loam

TABLE 2

Showing the average depth of water in each field during its preparation

FIELDS ^a	PLOWING		HARROWING							AVERAGE
	Before and during	After	1st	After 1st	2nd	After 2nd	3rd	After 3rd	4th	
	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.
B-1.....	7.6	25.2	—	12.7	—	13.9	—	15.2	—	14.9
B-2.....	6.3	30.0	—	12.7	—	10.1	—	15.2	—	14.9
B-3.....	5.7	29.0	—	10.0	—	9.5	—	7.0	—	12.2
Ca-1.....	6.7	7.0	—	8.4	—	11.2	—	5.5	—	7.8
Ca-2.....	6.8	6.1	—	5.9	—	12.3	—	5.4	—	7.3
Ca-3.....	6.8	6.7	—	8.4	—	8.8	—	—	—	7.7
Ca-4.....	7.2	5.0	—	12.3	—	5.2	—	—	—	7.4
Cn-1.....	8.9	15.9	16.5	15.2	10.2	16.5	11.4	16.5	—	13.9
Cn-2.....	7.2	16.5	17.8	17.8	10.8	15.2	8.9	17.8	—	14.1
Cn-3.....	8.9	15.9	19.0	15.9	14.4	17.8	8.9	12.6	—	14.4
Cn-4.....	5.1	16.5	16.5	19.1	12.7	16.5	12.7	19.1	—	14.8
Cn-5.....	9.5	17.8	22.9	20.3	7.6	17.8	9.5	19.7	—	14.4
Cn-6.....	8.3	17.1	17.2	15.2	9.5	17.8	12.7	21.0	—	14.8
Cn-7.....	7.3	17.2	17.9	17.9	11.4	15.9	8.9	16.5	—	14.1
Cn-8.....	4.3	16.5	12.3	18.3	10.7	23.6	4.3	—	—	12.9
Cn-9.....	6.8	12.3	9.5	20.2	8.2	19.7	8.8	5.1	3.6	10.5
Cn-10.....	4.2	12.6	13.2	17.2	11.2	20.5	7.2	6.4	2.3	10.6
Cn-11.....	5.3	15.3	12.3	21.4	8.2	16.7	4.0	—	—	11.9
Cn-12.....	7.1	15.3	8.5	17.7	6.8	16.5	4.1	—	—	10.9
Cn-13.....	6.1	10.2	16.2	15.5	10.2	13.7	4.2	—	—	10.9
Cn-14.....	10.7	4.6	9.4	3.0	9.1	2.2	4.5	.3	—	5.5
Cn-15.....	9.1	3.5	11.7	4.2	13.5	3.3	14.4	3.0	—	7.8
Cn-16.....	8.2	5.5	14.1	4.2	14.7	3.5	14.1	2.8	—	8.4
R-1.....	9.4	—	14.4	—	4.5	4.0	1.6	—	—	6.8
R-2.....	9.4	—	12.7	—	12.0	12.0	1.9	—	—	9.6
R-3.....	8.0	—	16.8	—	17.0	13.7	1.1	—	—	11.3

^aB are in Biñang; Ca, in Calamba; Cn, in Calauan; and R, in Santa Rosa.

up to draining for harvest

No.	Days						AVERAGE
	13th	14th	15th	16th	17th	18th	
4	1.4	16.9	17.5	17.5	drained	—	cm.
9	16.7	17.0	17.5	15.8	drained	—	8.5
5	17.7	16.9	17.2	16.7	drained	—	9.3
5	drained	—	—	—	—	—	10.0
1	4.8	drained	—	—	—	—	8.8
6	drained	—	—	—	—	—	9.1
9	drained	—	—	—	—	—	3.4
2	15.2	—	15.2	drained	—	—	3.9
3	15.9	—	17.2	drained	—	—	12.6
3	17.8	—	17.8	17.8	17.8	drained	13.1
5	—	16.5	16.5	16.5	16.5	drained	15.4
3	—	17.8	17.8	17.8	17.8	drained	14.1
2	—	17.2	17.2	17.2	17.2	drained	14.9
3	—	14.0	14.0	14.0	14.0	drained	15.2
3	7.2	drained	—	—	—	—	12.9
3	drained	—	—	—	—	—	7.3
3	—	—	—	—	—	—	6.0
3	—	—	—	—	—	—	9.4
3	—	—	—	—	—	—	7.5
3	—	—	—	—	—	—	11.2
3	8.3	—	—	—	—	—	9.8
3	—	5.1	drained	—	—	—	6.2
3	—	5.4	drained	—	—	—	7.8
3	3.1	4.2	drained	—	—	—	7.9
3	1.6	.1	.6	drained	—	—	2.5
3	drained	—	—	—	—	—	2.9
3	—	2.3	2.2	1.8	drained	—	2.7

TABLE 4

Showing minimum and maximum depths of irrigation water and the stages of plant growth when applied

FIELDS ^a	MINIMUM	WEEK AFTER PLANTING	MAXIMUM	WEEK AFTER PLANTING	VARIETIES
	cm.		cm.		
B-1.....	.4	4th	17.5	15th	Inadhika
B-2.....	.4	4th	17.5	15th	"
B-3.....	.7	8th	17.7	13th	"
Ca-1.....	3.9	1st	15.6	9th	Mangasa
Ca-2.....	3.1	1st	15.3	11th	"
Ca-3.....	.9	9th	5.9	1st	"
Ca-4.....	1.7	9th	6.6	1st	"
Cn-1.....	7.0	1st	16.2	5th	Guinangang
Cn-2.....	6.4	1st	17.2	16th	"
Cn-3.....	9.5	1st	17.8	13th	"
Cn-4.....	7.0	1st	16.5	12th	Binicol
Cn-5.....	7.0	1st	17.8	12th	"
Cn-6.....	7.0	1st	17.2	12th	"
Cn-7.....	5.7	1st	15.9	6th	"
Cn-8.....	2.2	1st	12.6	4th	"
Cn-9.....	2.8	1st	10.3	3rd	Guinangang
Cn-10.....	4.2	1st	16.6	3rd	Binicol
Cn-11.....	3.2	1st	14.6	7th	Guinangang
Cn-12.....	2.7	1st	16.1	6th	"
Cn-13.....	2.0	1st	13.1	3rd	"
Cn-14.....	.5	1st	8.9	3rd	Binangbang-puti
Cn-15.....	1.2	1st	14.4	3rd	Guinangang
Cn-16.....	.1	1st	14.7	7th	"
R-1.....	.1	13th	5.2	2nd	Nagsalit
R-2.....	.4	8th	5.4	12th	Macan
R-3.....	.8	2nd	6.6	1st	Nagsalit

^a B are in Bifang; Ca, in Calamba; Cn, in Calauan; and R, in Santa Rosa.

TABLE 5

Showing the average depth of water and number of irrigation days for each variety

VARIETIES	AVERAGE			IRRIGATION DAYS:		YIELD PER HECTARE
	Minimum	Maximum	Depth	during pre- paration	during crop growth	
	cm.	cm.	cm.	average	average	cansas
Binangbang-puti.....	.5	8.9	6.2	53	107	58.2
Binicol.....	5.5	16.1	12.3	43	115	40.9
Guinangang.....	3.9	14.9	10.1	42	109	49.5
Inadhika.....	.5	17.6	9.3	41	110	33.9
Macan.....	.4	5.4	2.9	7	102	17.0
Mangasa.....	3.5	15.5	9.0	50	108	50.9
Nagsalit.....	.5	5.9	2.6	48	123*	56.0

TABLE 6

Summary

FIELDS ^a	IRRIGATION:						TOTAL DAYS FIELD WAS IRRI- GATED	YIELD PER HEC- TARE	VARIETIES
	during preparation		during the growth of the crop						
	Days ir- rigated	Average depth	Days drained	Days sub- merged	Days ir- rigated	Average depth			
		<i>cm.</i>				<i>cm.</i>		<i>cavans</i>	
B-1.....	41	14.9	20	90	110	8.5	151	29.5	Inadhika
B-2.....	41	14.9	15	95	110	9.3	151	35.5	"
B-3.....	41	12.2	14	96	110	10.0	151	37.0	"
Ca-1.....	50	7.8	15	93	18	8.8	158	51.5	Mangasa
Ca-2.....	50	7.3	15	93	108	9.1	158	50.3	"
Ca-3.....	49	7.7	14	69	83	3.4	132	?	"
Ca-4.....	49	7.4	14	69	83	3.9	132	?	"
Cn-1.....	38	13.9	52	64	116	12.6	154	57.3	Guinangang
Cn-2.....	38	14.1	52	64	116	13.1	154	63.1	"
Cn-3.....	38	14.4	57	59	116	15.4	154	55.0	"
Cn-4.....	48	14.8	60	57	117	14.1	165	47.2	Binicol
Cn-5.....	42	14.4	64	52	116	14.9	158	41.3	"
Cn-6.....	47	14.8	60	57	117	15.2	164	44.4	"
Cn-7.....	45	14.1	54	61	115	12.9	160	40.6	"
Cn-8.....	39	12.9	49	64	113	7.3	152	34.2	"
Cn-9.....	38	10.5	53	57	110	6.0	148	60.7	Guinangang
Cn-10.....	34	10.6	84	26	110	9.4	144	36.9	Binicol
Cn-11.....	46	11.9	83	28	111	7.5	157	38.4	Guinangang
Cn-12.....	34	10.9	87	25	112	11.2	146	35.9	"
Cn-13.....	42	10.9	84	31	115	9.8	157	42.6	"
Cn-14.....	53	5.5	43	64	107	6.2	160	58.2	Binangbang-puti
Cn-15.....	52	7.8	31	60	91	7.8	143	42.8	Guinangang
Cn-16.....	53	8.4	40	56	96	7.9	149	49.5	"
R-1.....	35	6.8	70	59	129	2.5	164	59.0	Nagsalit
R-2.....	7	9.6	52	50	102	2.9	109	17.0	Macan
R-3.....	60	11.3	61	56	117	2.7	177	53.0	Nagsalit

^a B are in Biñang; Ca, in Calamba; Cn, in Calauan; and R, in Santa Rosa.

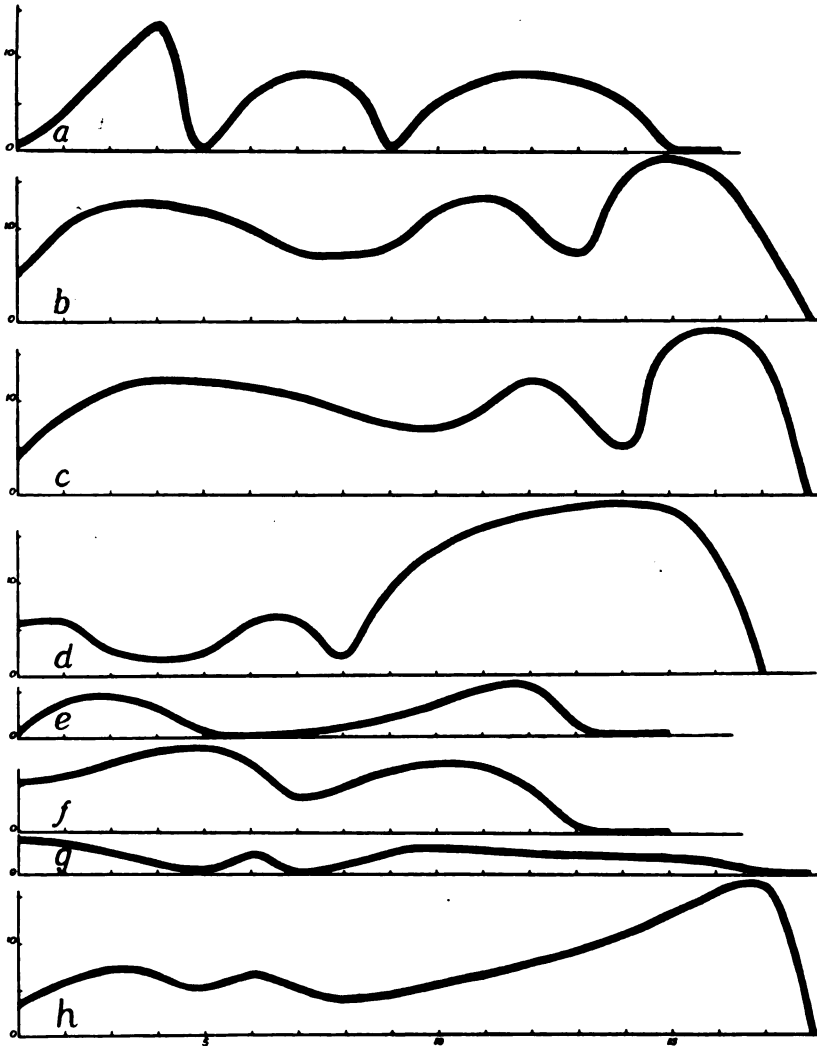


Plate I

Probable irrigation curves for a few varieties of lowland rice in Bifang, Calamba, Calauan, and Santa Rosa, Laguna.

a.—Binangbang-puti; *b.*—Binicol; *c.*—Guinangang; *d.*—Inadhika; *e.*—Macan; *f.*—Mangasa; *g.*—Nagsalit; and *h.*—for any variety (a general curve developed from the curves *a*, *b*, *c*, *d*, *e*, *f*, and *g*).

Vertical axis represents depths in centimeters, and horizontal axis represents weeks.

A PROMISING CASSAVA GRATER FOR THE FARM¹

ZOSIMO MONTEMAYOR

Of the Department of Agronomy

WITH TWO TEXT FIGURES

The need for a portable and at the same time an efficient cassava grater on the farm, especially where cassava is raised as an important part of the food stuff is obvious. This condition exists in many parts of Mindanao and other regions of the Philippines. Furthermore, an efficient cassava grater or crusher would encourage cassava cultivation as the machine would be of great help to the farmers in converting their cassava crop into utilizable forms, such as cassava meal, flour, and starch. If a farmer had a grater the cassava crop would not be left in the fields waiting for market for the fresh product, a practice that causes a loss of crop through decay or through woody formation in the old roots.

With these conditions in view, the writer attempted to devise what he hopes will be a useful cassava grater for the farm. The machine may be useful in preparing fresh storage roots other than cassava into meal which can be used for immediate feeding, for drying, and for flour making.

REVIEW OF LITERATURE

In the Philippines little has been written on cassava graters. Copeland (1908) mentions that ordinary thin sheets of galvanized iron or cut sheets from tin cans in which holes had been punched were used by the Filipinos in making cassava meal by rasping. A machine operated on the same principle (rasping) was constructed some years ago by Prof. Harold Cuzner then in this College, but this machine is primarily for the extraction of starch, and is run by motor. A figure used by Blokzeijl (1922) in his book, *De Cassave* shows similar appliances used in some cassava starch factories in Java. In South America where, according to Nichols (1920), the preparation of the meal from cassava is on a comparatively large scale, the grating is done in most cases by rasping, a process identical to that used in Java and in Cuzner's machine. It may be of interest to quote the following from Nichols on this subject:

The natives fix a large grater against a tub, and leaning over it with tubers in each hand, they grate quickly and rhythmically to the sound of a drum and they are encouraged to extra exertions by the stimulating influence of inspiring local songs. . . .

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The writer wishes to acknowledge the help extended by Prof. M. B. Raymundo through the use of the Agronomy Blacksmith Shop. Thanks are also due to Dr. N. B. Mendiola for suggestions and to Dr. T. Vibar for his encouragement in the construction of the machine.

Obviously it is a laborious task to grate cassava with such simple and crude appliances. Also it is very slow work as one can grate only about four kilograms of cassava an hour. In addition to its being slow and hard work the grated material may not be very appetizing for food owing to dirt and peeling getting in during the grating. In figure 1, are shown two typical native graters (2) and (3) formerly used in this College in the production of cassava meal.



Fig. 1.—Some of the native tools (2) and (3) used in grating cassava compared with the portable cassava grater. Each is operated by one man power.

DESCRIPTION OF GRATER

In the construction of the Cassava grater the following materials were used:

2 pcs. of board 10'×1" @ P0.10.....	P 2.00
1 pc. for legs 12'×3"×3".....	0.30
1 pc. for beams 1"×4"×3".....	0.50
1 pc. yacal for the axle.....	0.20
4/5 galvanized iron roofing plain @ P2.10.....	1.60
3 bolt 3"×1/4".....	0.06

1 hinge.....	0.20
6 screws @ ₱0.01.....	0.06
2 iron tires @ ₱0.50.....	1.00
Cost of material.....	₱ 5.92
Cost of labor for construction @ ₱1.50 for 12 days.....	18.00 ²
Total cost of construction.....	₱23.92

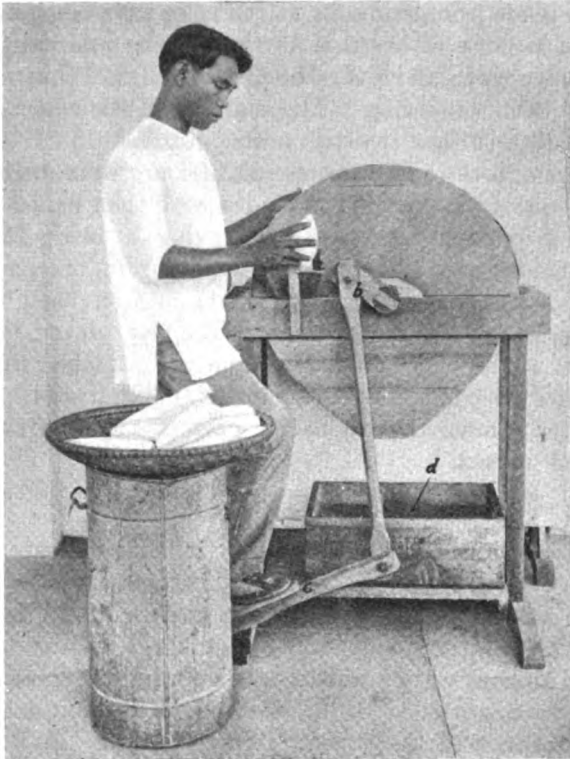


Fig. 2.—Side view of the grater showing (a) feeder; (b) lever; (c) pedal and (d) box containing grated cassava.

Before the construction of the grater, trials were made on the size of the holes that were to be made in the blades. Two sizes were used, one 1.5 mm. in diameter and the other is 2.5 mm. The 2.5 mm. holes were found to grate the faster. But it was finally decided to use both sizes of holes, one on each blade.

The wheel is in the form of a drum 36 cm. in diameter, with two circular boards an inch in thickness as sides. A hole 6 cm. square was made in the middle of each board through which the axle was put. The sides

²The carpenter who was employed to construct this device says that the cost of construction can be reduced to ₱15.00.

of the drum were then nailed to this axle, after which a sheet of plain galvanized iron was nailed around the sides to prevent water or grated material from getting into the drum.

The blades are of plain galvanized iron circular in shape and 60 cm. in diameter. On one, 6 rows of holes 2.5 mm. in diameter and arranged in quincunx were made, and on the other, 8 rows of 1.5 mm. holes. These holes were made by driving a sharpened nail through the marked points. To prevent the blade from wrinkling as the holes were being made the blade was laid flat on a piece of board. As soon as the nail went through, the blade was lifted so as to allow the bending of the nail thus making all the holes slant in same direction. This slanting of the edges of the holes is necessary to make a surface that will grate.

To give strength to the blades, circular frames were made out of wood and reinforced with iron tires. The blades were then nailed to the frames and the central portion was cut out leaving a blade 15 cm. wide all around. The blades were then attached to the drum, one on each side.

The box and the stand were next made and on each side a feeder was provided. To operate the grater with the feet a lever, the principle of which is that of the sewing machine treadle was attached to it. Figure 2 shows the device as completed when tested February 14, 1928; figure 1 shows the grater compared with native graters. As can be seen each is operated by one person.

RESULTS OF TRIALS

In the first trial made it was found that the machine grated 15 kilograms in 35 minutes or at the rate of about 27 kilograms an hour. In this trial only the blade with the larger sized holes was used. In the second trial made on February 14, the blade with the smaller holes was used and a rate of 23 kilograms an hour was obtained. On February 16 some 102 kilograms of grated cassava was needed in the Experiment Station and the machine was used. According to the *capataz* under Prof. M. B. Raymundo who supervised the work at the time it took about four hours for the laborer to grate all the cassava needed. On an average, therefore, the grater can grate 25 kilograms an hour. The results of the three trials made are tabulated below:

DATE	TIME SPENT	ACTUAL AMOUNT GRATED	COMPUTED RATE PER HOUR	AVERAGE RATE PER HOUR
	<i>Hr. Min.</i>	<i>Kgm.</i>	<i>Kgm.</i>	<i>Kgm.</i>
Feb. 11, 1928.....	— 35	15	27	—
Feb. 14, 1928.....	1 —	22	22	25
Feb. 16, 1928.....	4 —	102	25.5	—

The 102 kilograms grated on February 16, 1928 would have cost the College some ₱0.40 for the labor at the wage rate of 10 centavos an hour. Had the native graters been used, with which according

to trials made the same day a laborer could grate about 4 kilograms an hour, this quantity (102 kgm.) of grated cassava would have cost for the labor alone ₱2.50. The saving in labor was easily ₱2.10.

Although it is hoped that the grater can be improved and be made of material such that it can be hitched to a horse power engine, for ordinary farm use the wooden machine will answer. The feeder, however, can be made larger so that the ordinary large storage roots of cassava or of other root crops need not be cut into small pieces to fit the feeder.

The machine may also be used to grate root crops which are chopped or sliced and dried for future use. For hog and for poultry raisers who may use cassava or other root crops as part of rations the machine would be very helpful in the preparation of the meal, either for immediate feeding or for drying for future use. Flour is easily made from the meal produced by this grater.

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ZACATE AND WATER CONSUMPTION OF PHILIPPINE HORSES¹

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Zacate, or cut green forage given to animals, known among American farmers as soilage, is the only roughage supplied to stable horses in the Philippines. This limitation in roughage is principally because these soiling crops are healthful and have a high nutritive value and there is a lack of cheap hay materials in the Islands. For economic and other reasons, it is important, then, that the capacity of Philippine horses for soilage be known.

The role water plays in carrying on the vital processes in the animal body is well known. So it is also important that knowledge of the quantity of water consumed by Philippine horses be made available.

OBJECT

The experiments reported in this paper were undertaken to determine the soilage and water consumption of Philippine horses and its relation to the weight of the animals.

TIME AND PLACE

The work was conducted at the College of Agriculture, University of the Philippines.

The first set of the experiments on soilage consumption was carried on from October, 1922, to April, 1923, covering a period of seven months. Later trials on soilage and water consumption were made from November, 1927 to November 1928, or a period of one year.

HORSES

Ten horses were used in this experiment, consisting of four geldings, four stallions, and two mares. Six are of native blood. Of the other four, Councilor and Queen possess Welsh blood, Prince is with Arabian infusion and Licus is an American grade. The range in age was from 3 to 10 years at the beginning of the tests, their average age being 7.9 years. None of the animals was too old to make use of its teeth to properly masticate its feed. The average height is 126 cm. The weights given are the averages of the weekly weights throughout the period of experiments. The general average is 231.2 kgm. the lightest horse weighing 176.4 kgm. and the heaviest 253.1 kgm. (see table 1).

¹Experiment Station contribution No. 592 Received for publication December 3, 1928.

All horses were worked now and then for riding or driving in a calesa. This work was light and served to exercise and maintain the health of the animals, Councilor and Licus were put to hard labor occasionally.

TABLE 1

Showing the breed, sex, age, height, and weight of horses

HORSES	BREED	SEX	AGE	HEIGHT	AVERAGE WEIGHT
			<i>year</i>	<i>cm.</i>	<i>kgm.</i>
Service.....	Native.....	Gelding.....	10	128.0	244.0
Monday.....	Native.....	Gelding.....	10	131.0	252.2
White.....	Native.....	Gelding.....	9	114.0	176.4
Licus.....	American grade.....	Stallion.....	9	129.0	253.1
Councilor.....	Welsh grade.....	Gelding.....	6	129.0	229.7
Sultan.....	Native.....	Stallion.....	15	129.5	234.6
Luck.....	Native.....	Stallion.....	5	127.0	217.4
Prince.....	Arabian grade.....	Stallion.....	3	131.0	221.8
Capitana.....	Native.....	Mare.....	7	121.0	251.6
Queen.....	Welsh grade.....	Mare.....	4½	120.0	230.9
		Average.....	7.9	126.0	231.2

SOILAGE

Various kinds of soiling crops were used during the investigation. These include roughages which were available and ordinarily fed to stable horses in the College. The main portion of the soilage used consisted of Guinea grass and corn fodder. When these were not available Napier grass or cogon were used, especially during the dry season when the production of soilage is generally low.

One important criterion observed in the selection of forages before feeding them was the stage of development of the plants. In any case the grass was fed when neither too young to give very laxative effect on the animal nor too old and coarse to be unpalatable and probably constipating. With the corn plant this stage is between tasseling and glazing periods, although some times the plant was used when the kernels were at the milk stage. Guinea grass is generally most suitable for feeding when the inflorescence begins to show in the field. Napier grass is never too old to feed because the tops, consisting of the leaves and juicy stalk, are always tender enough for feeding, but very young new shoots of this grass are likely to give watery feces when taken in large amounts. Cogon was used when very young. This grass is never too young for feeding purposes. But it grows very rapidly and becomes fibrous rendering it unpalatable and low in nutritive value when old.

To lessen waste in the feeding of corn and Napier grass these feeds were always passed through a cutter reducing the stalks into sections of one-half of an inch in length so that both leaves and stalks are eaten by the horse.

WATER

Ordinary tap water from a mountain stream was used. In no case was any material such as common salt and molasses which may stimulate greater consumption of water used.

FEEDING, WATERING, AND MANAGEMENT

The horses were all given full feed. The first feeding was made at 6:30 a. m., the second at noon, the third at 3:00 p. m. and the fourth and last feeding at 6:30 p. m. As much roughage was placed in the manger each time as the animals would consume leaving only the rougher unpalatable parts of the feed uneaten. Whenever an animal got off its feed, consuming only a relatively small portion of the feed given, the appetite was stimulated back to normal by supplying very much less of the feed the next feeding time. The usual grain feed given to horses was furnished them.

In determining the consumption of soilage the weighings of the materials supplied to each horse during the day were recorded and totalled. The feed left in the manger was collected the next morning and weighed. The difference between the total weights supplied to each animal and that of the left-over represents the amount consumed during the test day.

Watering was done at the same time that the animal was given the soilage. Direct readings of the weights of water before and after each horse drank were made, the difference representing the amount consumed. The total weight of water consumed four times during the day gives the consumption for that day.

All the horses used in this investigation were placed in separate stalls in the daytime where they were given their feed and water. At eight o'clock in the evening they were placed in separate boxstalls well bedded with straw; here they could lie down and relax. A box was kept in the boxstall where salt was placed, thus supplying the horses this mineral at will. The horses were taken from the boxstalls and put in the stalls each morning at six o'clock.

The necessary care, that is, bathing, currying, and general cleaning was given to all animals under observation. The health and manner of feeding of the animals were noted so that any unusual behavior of any individual which might introduce error in the results was immediately remedied. For instance, if a work horse had undergone strenuous labor so that his feeding was slow and abnormal he was eliminated during that day from the group being tested. Such cases, however, were few.

With the test carried out with Service, Monday and White, determination of soilage consumption was made daily during the period of the experiment. With the rest of the animals the test was made one day each week throughout the year. With the weekly tests only a single kind of forage was used during each test day.

Water consumption was taken also once a week.

TABLE 2
*Showing the average daily consumption of Guinea grass by
Philippine horses at ten-day periods*

TEN-DAY PERIOD	SERVICE	MONDAY	WHITE
	<i>kgm.</i>	<i>kgm.</i>	<i>kgm.</i>
First.....	13.3	15.2	10.8
Second.....	13.1	15.6	11.9
Third.....	14.6	16.7	14.5
Fourth.....	17.6	15.2	10.6
Fifth.....	16.8	15.1	12.5
Sixth.....	17.3	17.8	13.3
Seventh.....	—	16.9	13.5
Eighth.....	—	16.6	13.6
Ninth.....	—	16.7	13.4
Tenth.....	—	17.1	14.2
Eleventh.....	—	16.9	11.8
General average....	15.5	16.3	10.0

TABLE 3
Showing the average daily soilage consumption of Philippine horses by the month

MONTH	KIND OF SOILAGE	LICUS	COUNCILOR	SULTAN	LUCK	PRINCE	CAPITANA	QUEEN
1928	1928							
January...	Guinea grass.....	12.3	11.7	—	13.3	10.2	14.2	14.8
February...	Guinea grass and cut corn fodder.....	12.4	11.0	—	12.1	10.4	11.4	13.4
March.....	Guinea grass and cut corn fodder.....	16.0	13.8	15.6	12.2	10.4	12.7	—
April.....	Cut Napier grass and cut corn fodder.....	16.2	13.6	17.2	14.9	13.3	12.6	—
May.....	Guinea grass.....	6.7	13.3	16.6	13.3	13.9	13.3	—
June.....	Guinea grass.....	10.4	10.0	10.6	10.6	11.4	13.0	—
July.....	Guinea grass and cut Na- pier grass.....	10.7	12.5	13.8	14.4	10.9	—	11.4
August....	Cut corn fodder and cogon.....	14.9	13.9	13.4	14.7	14.5	—	19.5
September.	Cut corn fodder, cogon and Guinea grass.....	14.5	18.9	18.1	18.4	19.9	—	20.6
October...	Cut Napier grass, Guinea grass and cogon.....	11.5	14.6	15.2	14.2	13.3	—	19.3
November.	Cut corn fodder and Guinea grass.....	14.6	16.2	18.6	18.8	19.5	—	21.3
1927								
December.	Cut Napier grass and cut corn fodder.....	13.7	12.6	—	13.3	13.7	13.6	13.4
	Average.....	12.8	13.5	15.5	14.2	13.5	13.0	16.7

DISCUSSION OF RESULTS

Soilage consumption

Table 2 shows the 10-day average of Guinea grass consumed by three horses daily. With Service the average ranges from 13.1 to 17.6 kgm.; with Monday, from 15.2 to 17.8 kgm.; and with White, from 10.6 to 14.5 kgm. The general averages are 15.5 kgm. for Service, 16.3 kgm. for Monday, and 10.0 kgm. for White.

In table 3 the monthly averages of soilage consumed by various horses daily are given. Guinea grass predominates among the grasses used during the experiment. Corn fodder was used to a slightly greater extent than Napier grass, while cogon formed part of the feeds given in August and September only. The minimum monthly average of soilage consumed by the animals is 10.0 kgm. a day. This record was made by Councilor. The maximum monthly average consumption was 21.3 kgm. a day, which was made by Queen. The yearly average shows that Licus consumed the smallest amount or 12.8 kgm. a day and Queen the maximum amount or 16.7 kgm. a day. The following horses consumed intermediate amounts; Capitana, 13.0 kgm. daily; Prince and Councilor, 13.5 kgm. each; Luck, 14.2 kgm.; and Sultan, 15.5 kgm.

The general average soilage consumption for all the ten horses was 14.1 kgm. daily (see table 5).

TABLE 4

Showing the average daily water consumption of Philippine horses by the month

MONTH	LICUS	COUNCILOR	SULTAN	LUCK	PRINCE	QUEEN	CAPITANA
1928	<i>kgm.</i>	<i>kgm.</i>	<i>kgm.</i>	<i>kgm.</i>	<i>kgm.</i>	<i>kgm.</i>	<i>kgm.</i>
January.....	10.6	11.1	—	8.5	7.1	8.9	6.7
February.....	8.6	9.4	—	6.5	3.5	9.7	5.6
March.....	6.9	10.0	8.4	6.5	4.8	—	5.1
April.....	11.3	10.4	11.5	9.3	6.3	—	9.0
May.....	10.3	10.0	10.5	7.5	5.2	—	5.5
June.....	10.4	9.2	9.8	6.8	6.3	—	5.2
July.....	12.2	9.7	12.3	6.7	5.4	4.8	—
August.....	13.7	11.8	—	8.9	5.7	9.8	—
September.....	10.2	7.1	5.2	6.3	3.3	2.1	—
October.....	12.2	7.8	13.2	8.5	6.2	6.6	—
November.....	8.0	8.4	10.2	5.6	4.4	2.5	—
1927							
December.....	9.0	12.9	—	8.3	3.6	9.7	5.8
Yearly average.....	10.3	9.8	10.1	7.5	5.2	6.8	6.1

Water consumption

Table 4 shows the monthly average amount of water consumed by seven horses daily during one year. It is apparent that there is a great variation in the amount of water each animal consumed. As will be seen

later, the size of the animal does not necessarily indicate its ability to consume water. Contrary to expectation, the monthly average consumption is not markedly influenced by climatic conditions obtaining during certain seasons of the year. This is true with practically all horses in the experiment. It is possible that were these horses exposed in the pasture the thirst for water would have been greater when the temperature was high and weather conditions dry. Even with stabled horses, however, the avidity for water is some less when the weather is rainy and cool.

The variations in the water consumption of horses show that Queen drank the lowest average amount, 2.1 kgm. a day in September and Licus the largest average amount, 13.7 kgm. a day in August. The general average for the year with all horses, ranges from 5.2 kgm. daily, with Prince, to 10.3 kgm. daily, with Licus. The other horses drank amounts between these extremes. Capitana consumed an average of 6.1 kgm. a day; Queen, 6.8 kgm.; Luck, 7.5 kgm.; Councilor, 9.8 kgm.; and Sultan, 10.1 kgm.

The yearly average water consumption of all horses is 8.0 kgm. a day. (see table 5).

TABLE 5

Showing the ratio between the water and soilage consumption and weight of Philippine horses

HORSES	AVERAGE WEIGHT OF HORSES	AVERAGE SOILAGE CONSUMPTION	YEARLY AVERAGE WATER CONSUMPTION	RATIO BETWEEN SOILAGE CON- SUMPTION AND WEIGHT OF HORSES	RATIO BETWEEN WATER CON- SUMPTION AND WEIGHT OF HORSES
	kgm.	kgm.	kgm.	1 to	1 to
Service.....	244.0	15.5	—	15.7	—
Monday.....	252.2	16.3	—	15.5	—
White.....	176.4	10.0	—	17.6	—
Licus.....	253.1	12.8	10.5	19.8	24.6
Councilor.....	229.7	13.5	9.8	17.0	23.4
Sultan.....	234.6	15.5	10.1	15.1	23.2
Luck.....	217.4	14.2	7.5	15.3	29.0
Prince.....	221.8	13.5	5.2	16.4	42.7
Capitana.....	251.6	13.0	6.1	19.4	41.3
Queen.....	230.9	16.7	6.6	13.8	35.0
Average.....		14.1	8.0	16.6	31.3

Ratio between soilage consumption and weight of horses

The relation with ten horses between the amount of soilage a horse can consume and its weight is shown in table 5. The range is from a ratio of 1:13.8 with Queen to 1: 19.8 with Licus, the average ratio being 1: 16.6. That is, for every 16.6 kgm. of the live weight of a horse he may be given one kgm. of green roughage. A narrow ratio indicates greater feeding ability of the animal and vice versa. As a rule, there is general uniformity

in the proportion of roughages which horses of different weights may consume.

Ratio between water consumption and weight of horses

Unlike the ratio between soilage consumption and weight of horses, the relation between water consumption and the size of the animal shows much greater variation, as may be seen in table 5. The ratio ranges from 1:23.2 with Sultan to 1:42.7 with Prince. The average for the seven horses used in the experiment is 1:31.3. This ratio shows that for every 31.3 kgm. of the live weight of the horse he may be given one kgm. of water to satisfy his need, or approximately 3 per cent of the weight of the animal. Heavy water drinkers show a narrow ratio, and vice versa.

SUMMARY OF CONCLUSIONS

From trials conducted with Philippine horses on water and soilage consumption the following conclusions are presented:

1. The average daily consumption of soilage is from 12.8 kgm. to 16.7 kgm., the average for all horses being 14.1 kgm.
2. The average amount of water drank by the horses daily is from 5.2 kgm. to 10.5 kgm., the average for all horses being 8.0 kgm.
3. The ratio between the amount of soilage consumed and the weight of horses is from 1: 13.8 to 1:19.8. The average ratio for all horses is 1: 16.6.
4. The ratio between water consumption and the weight of horses is from 1: 23.2 to 1: 42.7. The average ratio for all horses is 1: 31.3.

EFFECT ON YOUNG RICE PLANTS OF ADDING ALUMINUM SALTS TO COMPLETE CULTURE SOLUTIONS¹

FELIX VILLA

WITH SIX TEXT FIGURES

INTRODUCTION

Aluminum salts are reported as always present in the soil. They are absorbed by plants, and probably produce the toxic and stimulating effects similar to those obtained from pot and culture solution studies. But conditions not within the control of the investigators influenced most of the studies conducted in pot cultures. Of the solution studies made, the greater number were carried out by using cultures solutions that were not known to be suitable to the plants, and in some experiments the aluminum salts were added to only distilled water. Therefore, as might be expected, the results could not help but be harmful to the plants.

In the present study the aluminum salts, singly or separately, and in different amounts, were added to complete culture solutions. Some of these solutions are good, while the others are harmful to the young rice plants. In other words, the nutritive values for rice plants of the culture media here employed are definitely known. Hence, the results to be obtained from the present study may be considered as influenced by the aluminum salts employed.

Review of literature

Mirasol (1920) proved conclusively that aluminum is a determining factor in soil acidity. Based on results of their experiments on rye, barley, and pop corn, Conner and Sears (1922) report that the toxicity of aluminum salts was due to the aluminum ion more than it was to the hydrogen ion, and contend that acid soils are toxic to many plants largely because they contain soluble aluminum salts. Abbott, Conner, and Smalley (1913) found that aluminum nitrate was toxic to corn seedlings in dilute nutrient solutions and suggested that the acid radical might be the toxic agent. Miyake (1916) found that aluminum chloride was toxic to the rice plants grown in distilled water even in dilute solutions. The toxic effect was noticed when the salt was in a concentration greater than 0.000133 per cent. Hartwell and Pember (1918) found that aluminum sulfate was toxic to rye grown in a well balanced culture solution and suggested that the toxicity

¹ Thesis presented for graduation, 1928, for the degree of Bachelor of Agriculture from the College of Agriculture, No. 282; Experiment Station contribution No. 593. Prepared in the Department of Plant Physiology under the direction of Dr. Rafael B. Espino.

of this salt on barley was largely due to the aluminum. Stoklasa (1911) showed that a combined application of 9 kgm. (19.8 lbs.) of manganese and 4.48 kgm. (9.8 lbs.) of aluminum sulfate per hectare increased the yield of sugar beets from 30 to 50 per cent. He is of the opinion that aluminum is a catalytic agent, performing a function in the assimilation of carbon by promoting a more rapid process.

In investigating the effect of different salts of aluminum on the growth of *Zea mays*, *Vicia faba*, *Leus esculenta*, and *Helianthus annuus*, Kratzmann (1914) found that the growth was hindered by the salts when the concentration was 0.005 per cent, but stimulated when concentration was only

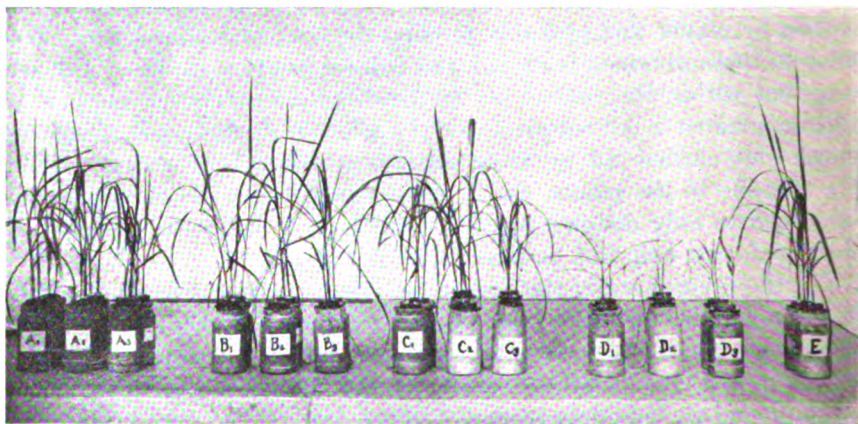


Fig. 1.—Young rice plants growing in complete culture solutions containing 0.00025, 0.0005 and 0.00075 gram-molecule of aluminum nitrate. Culture E, without aluminum.

0.0001 per cent. Aluminum nitrate showed a toxic effect. Yamano (1905) found that moderate amounts of aluminum salts had a stimulating effect upon the development of barley and flax but he reports that in water culture, 0.2 per cent of alum (ammonium alum, $\text{A}(\text{SO}_4)_2(\text{NH}_4) + 12 \text{ aq.}$) proved injurious after three weeks, while 0.8 per cent killed the plant.

Object of the present study

The present study was to determine the effect upon young rice plants of soluble aluminum salts added separately in different amounts to complete culture solutions, the relative nutritive values of which for the rice plant are known.

Time and place

This investigation was conducted in the Laboratory of Plant Physiology of the College of Agriculture, University of the Philippines, Los Baños. The experiments were begun in July, 1927 and were closed in February, 1928.

MATERIALS AND METHODS

The plant

Young plants of Hambas variety, a lowland rice, were used in this study. Seeds obtained from the Agronomy Department were soaked in water for twenty-four hours. They were then spread between sheets of blotting paper and kept there until they had started to germinate. The germinating seeds were spread on paraffined bobbinet tied over the mouth of a large museum jar containing tap water. The germinator was kept full of water and was kept in the glass chamber of the laboratory. When the seedlings were about six centimeters high, vigorous and uniformly developed seedlings were selected and planted in prepared culture bottles containing the culture solutions. Each culture bottle, which had a capacity of 60 cubic centimeters, was provided with a two-holed cork in which

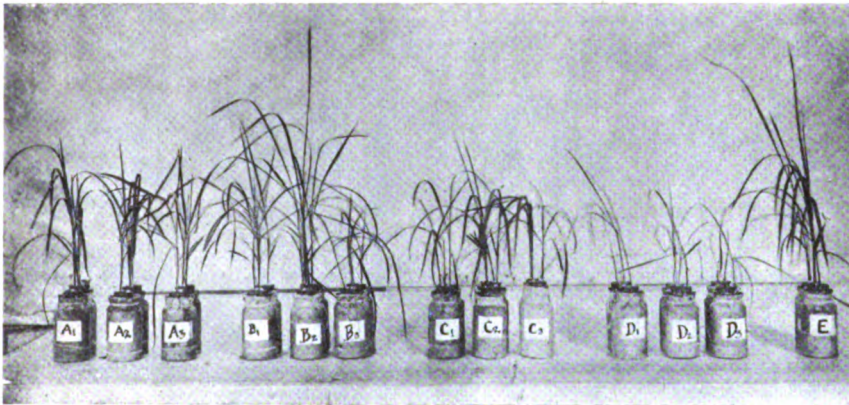


Fig. 2.—Young rice plants growing in complete culture solutions containing 0.00025, 0.0005 and 0.00075 gram-molecule of aluminum sulfate. Culture E, without aluminum.

the seedlings were mounted. The culture bottles were wrapped with carbon and Manila paper, to keep the roots of the plants in darkness. Loose cotton plugs, inserted in the holes of each cork, held the seedlings in good position. The cultures were kept in the glass chamber of the Plant Physiology laboratory.

The culture solutions

The aluminum salts. Aluminum nitrate and aluminum sulfate were used in this study. They were separately dissolved in distilled water in one molar concentration. Subsequent dilutions were made and each salt was finally added to the culture solutions in concentrations of 0.00025, 0.00050, and 0.00075 gram-molecule. This was later changed and during the latter part of the study the concentrations of the aluminum salts were in parts per million. One gram of each salt was dissolved in distilled water, to make a solution of one liter. One cubic centimeter of this solution when

diluted to 1000 cubic centimeters of the culture solution produced a mixture in which the concentration of the aluminum salt was one part per million. Each of the aluminum salts was added to the culture solution at concentrations of 3, 5, and 8 parts per million.

The four-salt solutions. The standard four-salt culture solutions were prepared as described by Espino in 1920. Only Baker's analyzed salts were used. Excluding the salt of aluminum, each culture solution had a total concentration of 0.002 gram-molecule (of all the salts taken together) per liter. The cultures designated A₁, A₂, and A₃ each had the four main salts (in gram-molecule) KH_2PO_4 , 0.00025; $\text{Ca}(\text{NO}_3)_2$, 0.000375; $(\text{NH}_4)_2\text{SO}_4$, 0.000375; and MgSO_4 , 0.001. Cultures B₁, B₂, and B₃ each had KH_2PO_4 , 0.00025; $\text{Ca}(\text{NO}_3)_2$, 0.00025; $(\text{NH}_4)_2\text{SO}_4$, 0.00025; and MgSO_4 ,

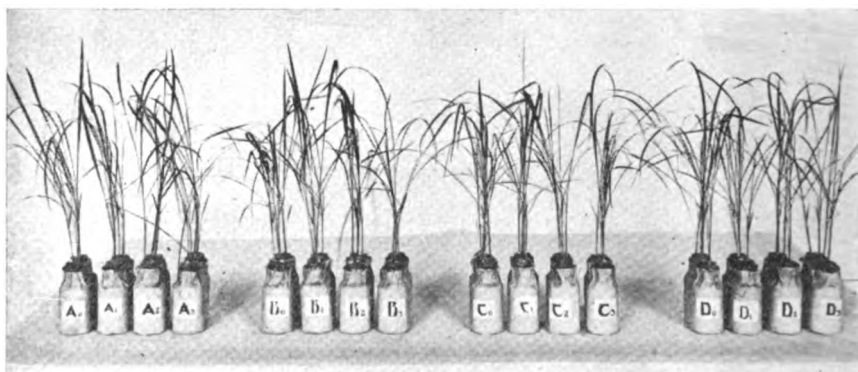


Fig. 3.—Young rice plants growing in complete culture solutions containing 0.00025, 0.0005 and 0.00075 gram-molecule of aluminum nitrate. Cultures A₀, B₀, C₀, and D₀, without aluminum.

0.000125. Cultures C₁, C₂ and C₃ each had KH_2PO_4 , 0.00025; $\text{Ca}(\text{NO}_3)_2$, 0.00125; $(\text{NH}_4)_2\text{SO}_4$, 0.00025; and MgSO_4 , 0.00025. Cultures D₁, D₂ and D₃ each had KH_2PO_4 , 0.00125; $\text{Ca}(\text{NO}_3)_2$, 0.00025; $(\text{NH}_4)_2\text{SO}_4$, 0.00025; and MgSO_4 , 0.00025 gram-molecule. To supply the plants with iron, a few drops of the solution of ferric phosphate were added to each culture medium. To serve as controls, cultures A₀, B₀, C₀, and D₀ were supplied with only the four main salts and a trace of iron as ferric phosphate; no salt of aluminum was added.

Culture solutions were renewed at the end of every two days, and this procedure was followed for a period of thirty days, or up to the time of harvest.

EXPERIMENTS AND RESULTS

Plan of the experiments

The different sets of cultures were conducted as follows:

Set I. This set was carried from August 9 to September 9, 1927. It consisted of 12 different cultures supplied with aluminum nitrate, each culture was in duplicate; and for control one culture grown in Espino's best four-salt culture solution without aluminum. A similar set of cultures was conducted at the same time, with the aluminum supplied as aluminum sulfate. The aluminum salts were added to the culture solutions in different amounts, (none for the control and 0.00025, 0.0005, and 0.00075 gram-molecule for the test cultures). The results are shown in table 1.

Set II. The plan of the experiment in set I was improved by including a control culture for each culture type. For example, culture Ao served as the control only for cultures A₁, A₂, and A₃. Culture types designated as B, C, and D each had a control culture in which the proportions of the main

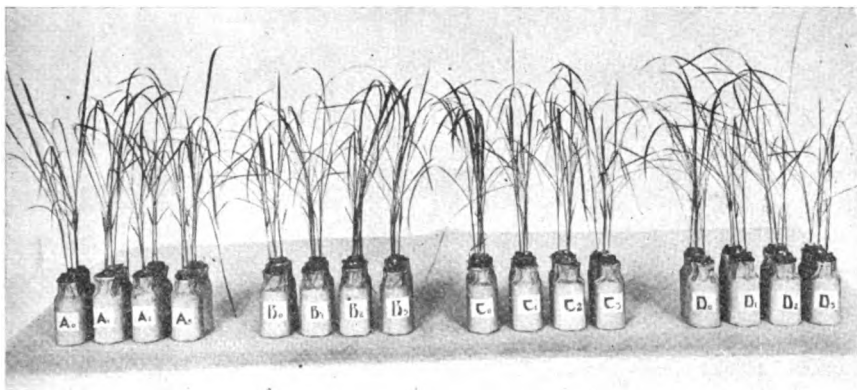


Fig. 4.—Young rice plants growing in complete culture solutions containing 0.00025, 0.0005 and 0.00075 gram-molecule of aluminum sulfate. Cultures Ao, Bo, Co, and Do, without aluminum.

salts were the same as those in test cultures. In set II, which was run from August 25 to September 25, 1927, the two aluminum salts, in amounts that were used in set I were added separately in gram-molecule and each culture was run in duplicate. The data obtained are in table 2.

This set of cultures was tried again from November 6 to December, 6, 1927 and the results are shown in table 3.

Set III. The presence of either aluminum salt, $(\text{Al}(\text{NO}_3)_3)$ or $\text{Al}_2(\text{SO}_4)_3$, in previous cultures proved harmful, that is, the plants from the control cultures were better than those from the corresponding test cultures. It was, therefore, decided to reduce the concentration or amount of the aluminum salts in the culture solutions. To effect this reduction

in concentration, the aluminum salts were added to the culture solution in term of parts per million. No aluminum salt was added to the control cultures, but the test cultures received an aluminum salt at the rate of 3, 5 and 8 parts per million. The experimental data are given in table 4. Following this scheme, a set of cultures (see table 4) was started January 20 and run to February 20, 1928. Owing to lack of time this set was not tried again.

Experimental results

External appearance of the plants. The general external appearance of the plants at the end of each experimental period was noted. A photograph of the plants grown in each set in one of the trials was taken at the end of the culture period (see fig. 1-6). The last vertical columns in tables 1-4 inclusive, show the data on the external appearance of the plants that were gathered at the time of harvest.

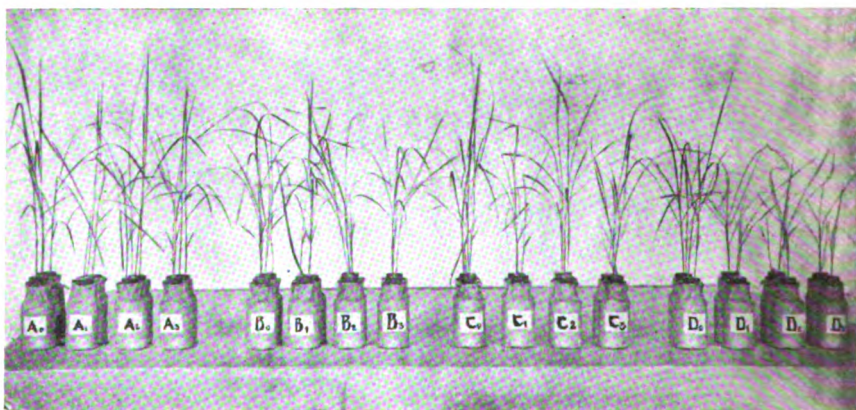


Fig. 5.—Young rice plants growing in complete culture solutions containing 3, 5 and 8 parts per million of aluminum nitrate. Cultures A₀, B₀, C₀, and D₀, without aluminum.

Height of tops and length of roots. At the end of each culture period, the highest top and longest roots of the two plants in each culture were measured. The average height of tops of each duplicate culture was taken expressed in "relative value" with reference to the control. The relative values of the heights of tops may be found in the third and fourth vertical columns in tables 1-4, inclusive.

The average length of roots of each duplicate culture was also taken. The fifth and sixth vertical columns in tables 1-4, inclusive, show the data on "relative values" of length of roots with reference to control.

Dry weight of plants. After measuring the height of tops and length of roots, the seeds were detached from the plants. The two plants from each culture were combined and wrapped with paper. They were then

dried to constant weight in an electric oven at about 100°C . The dry weights of the tops and of the roots were separately determined with the use of an analytical balance. The average weight of the plants (tops and roots) was taken and the data thus obtained are shown in the seventh and eighth vertical columns in tables 1 to 4, inclusive, expressed in "relative values" with reference to the control.

DISCUSSION OF RESULTS

General appearance of plants

All the plants grown in complete culture solutions to which aluminum salts in concentrations 0.00025, 0.00050, or 0.00075 gram-molecule were added were rather abnormally developed. In the four different culture types (A, B, C, and D) the test cultures, that is, those to which aluminum salts were separately added, produced plants which were decidedly inferior to those in the control cultures (see fig. 1-4, and description in tables 1-3).

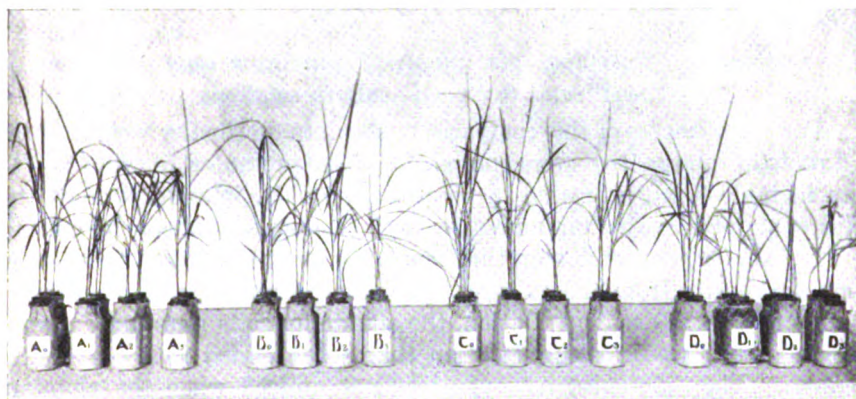


Fig. 6.—Young rice plants growing in complete culture solutions containing 3, 5 and 8 parts per million of aluminum sulfate. Cultures Ao, Bo, Co, and Do, without aluminum.

However, the plants from control cultures (E in fig. 1 and 2 and Ao and Bo in fig. 3 and 4) in which the plants were supplied with four-salt culture solutions known to be suitable for the normal growth and development of the young rice plants were normally developed. Hence, the aërial environment was satisfactory for the life of the plant, and the relatively poor results obtained from the test cultures in the same set must, therefore, be due to the influence of the aluminum salts that were added to the culture solutions. It should be said that the harmful effects of the aluminum salts upon the young rice plants were very marked. This condition was probably due to the fact that the aluminum salts were added to the culture solutions in comparatively large amounts.

In the latter part of this study, when the concentrations of the aluminum salts used were much lower (3, 5, and 8 parts per million) than the

amounts referred to above, the plants in the test cultures were quite well developed, very much better looking plants than those obtained from the test cultures in the first part of this study, where the concentrations of the aluminum salts were comparatively higher. The control cultures and test cultures produced plants (see table 4 and fig. 5 and 6) that were about equally developed.

Comparing effects upon the plant of nitrate and sulfate of aluminum

Examination of the data under columns I and II under each of the criteria in table 1, which were gathered simultaneously, will show that the aluminum nitrate in complete culture solutions was about as harmful as the aluminum sulfate, when supplied to the young rice plants under similar conditions. Similar relative results were obtained when the experiments, with slight modifications, were repeated, (see tables 2, 3 and 4). These findings confirm the toxic effects on rye of aluminum sulfate as were reported by Hartwell and Pember (1916) and the toxic effects on corn seedlings by aluminum nitrate, (Abbott, *et al* 1913).

Comparing effects upon rice plants of aluminum salts added to "good" and to "poor" culture solutions

For the purposes of this comparison, the data on the dry weight of tops and roots in tables 2 to 4 were compiled and are presented in table 5. The data in table 5 are expressed in percentages of the inferiority of the test cultures supplied with aluminum salts to the corresponding control cultures.

In table 5 it may be seen that, with few exceptions, and these exceptions are mostly from the cultures which were supplied with solutions of aluminum salts in extreme dilution, the aluminum salts were more harmful when added to a *poor* culture solution than when added to a *good* culture medium. The difference, however, was not noticed when the aluminum salts were employed in extreme dilution, 3, 5, and 8 parts per million.

Influence of concentration of aluminum salts

The presence in complete culture solution of aluminum sulfate in concentrations 3, 5, or 8 parts per million, although apparently harmful to the young rice plants under the criterion of dry weight of tops and roots, yet in term of height of tops, they produced stimulating effects. Most of the data on average height of tops in table 1 bear out this contention. The growth in length of the roots in several cultures was also apparently favorably influenced by the presence in the culture medium of a very small amount of either of the two aluminum salts. The decrease in dry weight of the plant accompanied by an increase in height of tops and in length of roots, ultimately resulted in a rather slender plant. Therefore, the decidedly marked effect upon the young rice plant of nitrate of aluminum when present in a very small amount in a complete culture, was to induce the plant to become slender.

Harmful effects of aluminum influenced by weather

The inferiority of the cultures supplied with either of the aluminum salts used when compared with the corresponding control cultures (without aluminum) was apparently partly due to weather. To help bring out this contrast clearly, table 6 is presented. In this table may be seen the weekly records of rainfall, temperature of the air, and the atmometric readings gathered during the time when the August 25 to September 25, and November 6 to December 6 cultures were being conducted. These weather records when correlated with certain data shown in table 5, likewise gathered during the same periods of time, will bring out the fact that as the weather conditions became less favorable for the young rice plant, the harmful effects of aluminum nitrate or of aluminum sulfate, became more intensified. The records of precipitation, of air temperature, and of evaporation and insulation obtained about the time when the August 25 to September 25 plantings were under observation, were a little higher than the corresponding weather records obtained about the time when the November 6 to December 6 plantings were made. It appears then that the weather conditions in the August 25 to September 25 plantings were more favorable for the development of the young rice plants than those in the November 6 to December 6 plantings. This contention is borne out by certain data in table 5, (from the third to the sixth columns). These columns of figures show that the inferiority of the test cultures to the corresponding control cultures (in term of dry weight of tops and root) obtained during the less favorable weather conditions was roughly 30 to 50 per cent. The temperature of air and intensity of sunlight (insulation) appear to be the influencing factors.

SUMMARY AND CONCLUSIONS

1. The toxicity of aluminum nitrate to young rice plants in complete culture solution was found to be about the same as that of the aluminum sulfate.
2. At concentration 0.00025, 0.0005 or 0.00075 gram-molecule, both aluminum nitrate and aluminum sulfate were more harmful when added to *poor* culture solutions than when added to *good* culture solutions.
3. Both salts of aluminum, $\text{Al}(\text{NO}_3)_3$ and $\text{Al}_2(\text{SO}_4)_3$ in a concentration of 3, 5 or 8 parts per million, when added to *poor* culture solutions and to *good* culture solutions produced about the same effects upon the young rice plants.
4. At a concentration of 3, 5 or 8 parts per million, both aluminum nitrate and aluminum sulfate, when separately added to complete culture solutions, stimulated the growth in height of the young rice plants, although apparently harmful under the criterion of dry weight of tops and roots.

5. As the weather conditions became less favorable, the harmful effects of aluminum nitrate or of aluminum sulfate upon the young rice plants increased. The inferiority of the test cultures to the corresponding control cultures (in term of dry weight of top and root) obtained during less favorable weather conditions was roughly 30 to 50 per cent.

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Showing data in "relative

CULTURE DESIGNATION	CONCENTRA- TION OF ALUM- INUM SALT ADDED TO CULTURE SOLUTIONS
A ₁	<i>gram-molecule</i> 0.00025
A ₂	0.00050
A ₃	0.00075
B ₁	0.00025
B ₂	0.00050
B ₃	0.00075
C ₁	0.00025
C ₂	0.00050
C ₃	0.00075
D ₁	0.00025
D ₂	0.00050
D ₃	0.00075
Control.....	none

^a I—Cultures supplied

^b II—Cultures supplied

Showing data in "relat
ni

CULTURE DENIGNATION	CONCENTRA- TION OF ALUM INUM SALT AD DED TO CUL- TURE SOLU- TIONS
	gram-molecul
A ₀ (control)	none
A ₁	0.00025
A ₂	0.00050
A ₃	0.00075
B ₀ (control)	none
B ₁	0.00025
B ₂	0.00050
B ₃	0.00075
C ₀ (control)	none
C ₁	0.00025
C ₂	0.00050
C ₃	0.00075
D ₀ (control)	none
D ₁	0.00025
D ₂	0.00050
D ₃	0.00075

^a I—Cultures sup

^b II—Cultures sup

Showing data in "relat
n

CULTURE DESIGNATION	CONCENTRA- TION OF ALUM INUM SALT ADDED TO CULTURE SOLUTIONS
	<i>p. p. m.</i>
A ₀ (control)	none
A ₁	3
A ₂	5
A ₃	8
B ₀ (control)	none
B ₁	3
B ₂	5
B ₃	8
C ₀ (control)	none
C ₁	3
C ₂	5
C ₃	8
D ₀ (control)	none
D ₁	3
D ₂	5
D ₃	8

^a I—Cultures sup

^b II—Cultures sup

TABLE 5

Showing data (in percentages), on the inferiority of the cultures with aluminum salts to the corresponding control cultures without aluminum (Compiled from tables 2 to 4 inclusive)

CULTURE DESIGNATION	CONCENTRATION OF ALUMINUM SALT	Al(NO ₃) ₃		Al ₂ (SO ₄) ₃		CONCENTRATION OF ALUMINUM SALTS	Al(NO ₃) ₃	Al ₂ (SO ₄) ₃
		a	a	a	a			
		Aug. 25 Sept. 25	Nov. 6 Dec. 6.	Aug. 25 Sept. 25	Nov. 6 Dec. 6	parts per million	Jan. 20	Feb. 20
	<i>gram-molecule</i>							
A ₁	0.00025	32	63	0	39	3	28	15
A ₂	0.00050	20	53	13	53	5	17	20
A ₃	0.00075	29	61	16	50	8	18	25
B ₁	0.00025	32	44	23	53	3	27	10
B ₂	0.00050	31	44	12	41	5	30	10
B ₃	0.00075	39	56	28	49	8	40	8
C ₁	0.00025	44	55	38	50	3	21	29
C ₂	0.00050	21	50	24	45	5	20	16
C ₃	0.00075	26	59	11	46	8	12	17
D ₁	0.00025	47	74	45	64	3	13	14
D ₂	0.00050	57	73	41	57	5	17	13
D ₃	0.00075	57	70	41	64	8	26	11

^a a and b under salts of aluminum, are results from two trials of a set of culture.

TABLE 6

Weekly weather records obtained from the records of the Weather Observer for the College of Agriculture

WEEK ENDING	RAINFALL	TEMPERATURE OF AIR			ATMOMETER READINGS	
		Max.	Min.	Mean	Evapora- tion	Insulation
1927	<i>mm.</i>	<i>°C</i>	<i>°C</i>	<i>°C</i>	<i>cc.</i>	<i>cc.</i>
Aug. 27	61.8	30.4	24.9	32.8	214	93
Sept. 3	15.2	31.0	24.6	27.8	218	113
Sept. 10	31.1	32.2	24.1	28.2	206	117
Sept. 17	28.5	31.2	24.1	27.7	122	104
Sept. 24	147.9	31.4	24.4	27.9	147	98
	284.5	32.1	24.4	28.9	907	525
Nov. 11	18.3	29.5	24.2	26.8	102	62
Nov. 18	53.0	29.1	24.6	26.8	89	68
Nov. 25	116.2	29.2	24.4	26.8	109	80
Dec. 2	0	29.6	23.4	26.5	169	103
Dec. 9	48.1	29.4	24.4	26.9	85	55
	235.6	29.4	24.2	26.7	554	368

A COMPARATIVE STUDY OF THE GROWTH AND DEVELOPMENT OF KIDS OF MILKING AND NON-MILKING DOES¹

LEONCIO M. LIMPIADO

WITH TWO CHARTS

The prospects for establishing goat dairies in the Philippines are bright. One of the problems generally attending a dairy establishment, however, is the raising of young animals. Hence, a study of comparing the growth and development of kids of does that are milked regularly with kids following mothers that are not milked at all should be of value. In this paper, the does that were milked will be designated as "milked does"; those that were not milked as "non-milked" does.

The objects of this investigation were to determine the comparative increase in weight and measurements in height at withers, length of back, length of rump, width of rump, heart girth, and circumference of barrel of kids of milking and non-milking does.

This work was conducted in the Department of Animal Husbandry, College of Agriculture, University of the Philippines, from January 18, 1925 to March 31, 1926, covering a period of one year, two months, and thirteen days.

MATERIALS

Animals

There were in all 34 kids used in this investigation, of which 22 were of the milking does and 12 of the non-milking mothers. All possessed Indian blood in varying proportions.

Ten of the kids of the milking does were females and the rest, or 12, were males. Five of the kids of the non-milking does were females and seven were males.

Feeds

The concentrates given to the milking does consisted of eight parts, by weight, of corn, five parts of copra meal, and one part of rice bran. For roughage, the animals had access to a variety of grasses and other succulence in the pasture where they were turned out during the day. At night they were supplied with either Guinea grass, Napier grass or corn fodder, depending on which one of these grasses was available.

¹ Thesis presented for graduation, 1927, with the degree of Bachelor of Agriculture from the College of Agriculture No. 283; Experiment Station contribution No. 594. Prepared in the Department of Animal Husbandry under the direction of Dr. Valente Villegas.

Pen and feed racks

The animals were provided with three pens where they were kept at night. One of these pens was used for the milking does, one for their kids, and one for the non-milking mothers and kids. All pens were fenced with woven wire 38 inches high nailed on ipil ipil posts. For the pen for milking does, poultry wire netting was placed over the woven wire fence so that the kids could not get into the pen during the night and nurse from their mothers. Sheets of galvanized iron were placed on the fence during stormy or rainy weather to protect the animals from rain and cold wind. In both pens the flooring was of dirt.

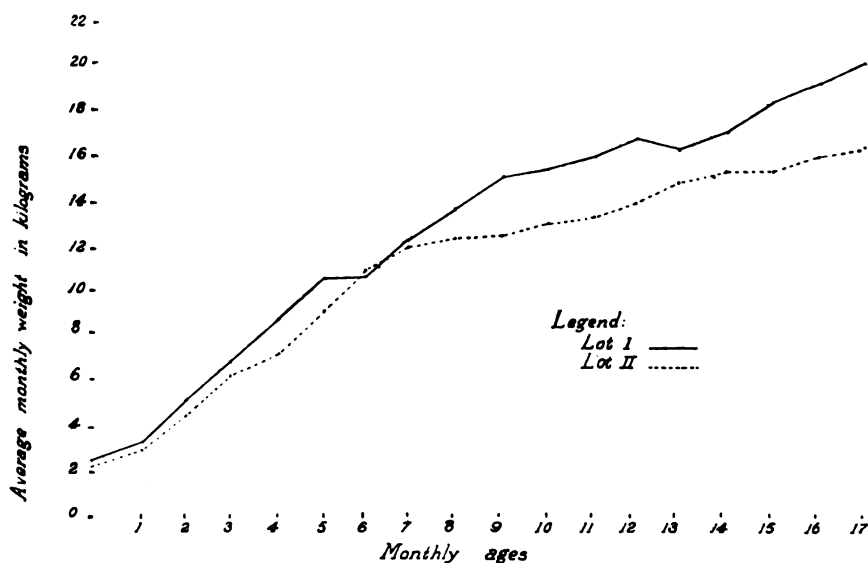


Fig. 1.—Showing weight-age curves of kids in lots I and II.

The feed racks were of two types and were made of wood. One type was for roughage and the other for concentrates. Both were so constructed as to prevent the animals from goring one another. Sections of bamboo with one side cut off were hung on the fences for salt troughs; common salt was placed in these once a week.

Milking stand

A stand was used in milking the does of lot I. It was made of wood and the platform was 68.5 centimeters high and large enough for the doe to stand on. A stanchion was provided on one end, and on both sides were wooden bars to keep the does from moving from one side to another. In front of the stanchion was a box in which concentrates were put for the does to feed on while they were being milked.

Measuring instruments

A wooden caliper, a meter stick, and a steel tape, all graduated into metric denominations were used in measuring the animals. They were weighed on a Fairbanks portable scale. A box of suitable height on which the kids were made to stand was found very convenient in making the measurements.

MANAGEMENT

The does and kids were separated into two groups. One group consisted of milking does with their kids, and the other group, of the non-milking mothers and their kids.

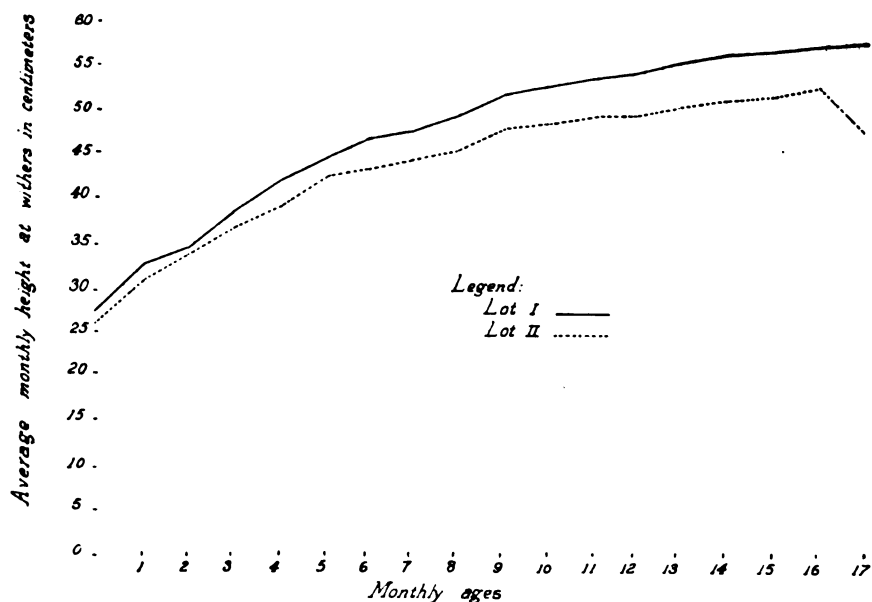


Fig. 2.—Showing height-at-withers-age curves of kids in lots I and II.

The milking does were those that were milked every day for dairy purposes. They were pastured in the daytime and at night they were kept in pens where they were given concentrates and roughage. The kids went with their mothers in the pasture in the daytime but they were separated at night. The kids and the mothers were given the same kinds of grain and forage at night.

From the sixth day after kidding till the end of lactation the milking does were milked dry in the morning.

The kids of non-milking does were with their mothers at all times. They were pastured in the morning and housed with the main herd in a goat pen at night. In contrast with the milking does, no feed was given to the non-milking mothers nor their kids in the pen at night, but, obviously,

the kids had access to the milk of their mothers at all times. The kids ran with their dams until they were weaned naturally.

Weighing and measuring the kids

During the whole period of the work, the weighing and measuring of all the animals of both groups were carried out weekly in the morning. The animals were placed squarely on their legs before any measurement was taken.

Measurements were taken on the left side of the animals only. The following points were determined and included in this report:

Weight. The weight records, in kilograms, were made directly from the readings of the scale.

Height at withers. The perpendicular distance from the ground to the top of the withers.

Length of back. The distance between the withers and the loin, (marked by a line connecting the hip bones).

Length of rump. The distance between the loin and the base of the tail.

Width of rump. The distance between the hips across the loin.

Heart girth. This measurement was taken around the chest of the animal just behind the shoulder.

Circumference of barrel. The measurement around the largest part of the barrel of the animal.

DISCUSSION OF RESULTS

For the sake of brevity, the kids of milking does will be designated as of lot I and those of the non-milking group as of lot II.

Weight

Table 1 shows that kids of lot I increased in weight steadily up to the age of 17 months, excepting in the thirteenth month when an average decrease of 0.13 kilogram was recorded. The largest increase took place in the fifth month when an average increase of 2.13 kilograms was made. In general, greater increases were made during the early age of the animals. Similar behavior in the rate of increases in weight was observed with animals of lot II. As in lot I, the greatest increase, an average of 2.00 kilograms, was in the fifth month. The rate of increase in lot I was generally higher than in lot II.

As is shown in figure 1, animals of lot I were, in general, heavier than those of lot II. It was only at the age of six months that animals of lot I were outweighed by those of lot II. At the beginning animals of lot I had an advantage over those of lot II, but the difference was small.

Height at withers

It may be seen in table 2, that in both lots I and II, the greatest increases in height of the kids were observed during the first month of age. Lot I had an average of 4.66 cm., and lot II, 4.16 cm. The increases became less as the animals advanced in age. Greater increases were recorded with animals of lot I than with those of lot II.

In figure 2, it may be seen that from the beginning to the age of 17 months, kids of lot I were taller than those of lot II.

Length of back

Table 3 shows that kids of lot I registered the greatest increase in length of back, an average of 3.04 cm. at the age of four months; while animals of lot II made the largest increase, an average of 2.59 cm., at the age of one month. In both lots the rate of increase became less as the animals grew older, but kids of lot I generally made greater increase in length of back than those of lot II.

Length of rump

Table 4 shows that in general the two lots of kids registered less and less increase in length of rump from the age of one month up to the seven-month. The maximum increase, an average of 1.26 cm., in lot I was at the age of one month; in lot II the maximum increase, an average of 1.89 cm., was at the age of four months.

Width of rump

According to table 5, kids of lots I and II made the greater increases in the first months. The maximum increase, an average of 1.39 cm., in the case of lot I was made at the age of four months. In the case of lot II the greatest increase, an average of 1.43 cm., was made at the age of one month. In general greater gains were made by animals of lot I than by those of lot II.

Heart girth

It is evident from data in table 6 that the increase in heart girth of animals of lots I and II was greater in the early age of the animals. In lot I, the highest recorded increase, an average of 4.57 cm., was at the age of two months; while with lot II the highest increase, an average of 4.45 cm., was at the age of three months. As a rule, greater increases were made by animals of lot I than by those of lot II.

Circumference of barrel

The increase in the circumference of barrel of both groups of animals, according to table 7, was greater during the early life of the kids. Animals of both lots made their maximum increase at the age of two months, an

average of 8.75 cm. for lot I, and 8.03 cm. for lot II. Greater increases were made generally by the animals of lot I than by those of lot II.

It is clear that the increase in weight and measurements of the different parts of the body of the kids in lot I was greater from the beginning up to the age of seventeen months than that of animals in lot II, the difference becoming greater as the animals grew older. The circumference of barrel of kids of lot II exhibited greater growth than those of lot I from the age of thirteen months up to the seventeenth month. At the age of seventeen months, both groups showed the same measurement. The general advantage of kids of lot I, or kids of the milking does, over those of lot II, or kids of the non-milking mothers, may be due partly to the slightly greater weight and size of the lot I kids at birth. As they grew older, and were separated from their mothers at night, the greater difference in growth and measurements of animals of lot I may be due mainly to the extra feeding they got at night in the form of concentrate and grass. It may be recalled that kids of lot II, those of non-milking mothers, as well as the dams themselves, did not have access to any feed at all during the night except the milk the kids received from their mothers.

SUMMARY AND CONCLUSION

In general, it may be said that kids following does used for dairy purposes may be raised at even greater advantage than those going with non-milking does. Therefore, it is safe to state that under normal conditions goat dairies can be made to produce milk as well as live animals for slaughter and for replacing old dairy stock.

TABLE 1

Showing the average monthly weight and increase in weight of kids in lots I and II

AGE	LOT I			LOT II		
	Number weighed	Average weight	Average increase	Number weighed	Average weight	Average increase
months		kgm.	kgm.		kgm.	kgm.
At birth	15	2.36	—	6	2.18	—
1	15	3.21	0.85	6	3.03	0.85
2	21	4.49	1.28	9	4.33	1.30
3	21	6.43	1.94	11	6.00	1.67
4	19	8.60	2.17	11	7.24	1.24
5	18	10.73	2.13	9	9.24	2.00
6	15	10.78	0.05	9	11.02	1.78
7	13	12.34	1.56	9	12.01	0.99
8	13	13.76	1.42	9	12.30	0.29
9	11	15.19	1.43	8	12.50	0.20
10	11	15.58	0.39	8	13.43	0.93
11	10	16.00	0.42	8	13.61	0.18
12	8	16.96	0.96	8	14.22	0.61
13	8	16.83	-0.13	7	15.40	1.18
14	8	17.62	0.79	7	15.84	0.44
15	7	18.41	0.79	7	15.92	0.08
16	7	19.60	1.19	6	16.73	0.81
17	7	20.37	0.77	5	17.14	0.41

TABLE 2

Showing the average monthly measurement and increase in height at withers of kids in lots I and II

AGE	LOT I			LOT II		
	Number measured	Average height	Average increase	Number measured	Average height	Average increase
months		cm.	cm.		cm.	cm.
Initial measurement	15	27.30	—	6	26.25	—
1	15	31.96	4.66	6	30.41	4.16
2	21	34.83	2.87	9	33.96	3.55
3	21	38.47	3.64	11	36.55	2.59
4	19	41.60	3.13	11	39.19	2.64
5	18	44.41	2.81	9	42.06	2.87
6	15	46.19	1.78	9	43.03	0.97
7	13	46.60	0.41	9	44.80	1.77
8	13	49.33	2.73	9	45.33	0.53
9	11	51.77	2.44	8	48.12	2.79
10	11	52.77	1.00	8	48.81	0.69
11	10	54.30	1.53	8	49.43	0.62
12	8	54.96	0.66	8	49.56	0.13
13	8	55.58	0.62	7	50.07	0.51
14	8	56.12	0.54	7	50.64	0.57
15	7	56.24	0.12	7	51.00	0.36
16	7	56.92	0.68	6	51.41	0.41
17	7	57.28	0.36	5	48.50	-2.91

TABLE 3

Showing the average monthly measurement and increase in length of back of kids in lots I and II

AGE	LOT I			LOT II		
	Number measured	Average measurement	Average increase	Number measured	Average measurement	Average increase
<i>months</i>		<i>cm.</i>	<i>cm.</i>		<i>cm.</i>	<i>cm.</i>
Initial measurement	15	18.86	—	6	18.16	—
1	15	21.76	2.90	6	20.75	2.59
2	21	23.66	1.90	9	23.16	2.41
3	21	26.09	2.43	11	24.75	1.59
4	19	29.13	3.04	11	27.09	2.34
5	18	31.32	2.19	9	29.33	2.24
6	15	32.86	1.54	9	29.41	0.08
7	13	32.84	-0.02	9	31.72	2.31
8	13	34.03	1.19	9	32.33	0.61
9	11	35.59	1.56	8	33.81	1.48
10	11	36.27	0.68	8	34.44	0.63
11	10	37.00	0.73	8	35.12	0.68
12	8	37.87	0.87	8	35.81	0.69
13	8	38.31	0.44	7	35.78	-0.03
14	8	39.00	0.69	7	36.28	0.50
15	7	39.28	0.28	7	36.64	0.36
16	7	39.28	0.00	6	36.50	-0.14
17	7	39.67	0.39	5	36.40	-0.10

TABLE 4

Showing the average monthly measurement and increase in length of rump of kids in lots I and II

AGE	LOT I			LOT II		
	Number measured	Average measurement	Average increase	Number measured	Average measurement	Average increase
<i>months</i>		<i>cm.</i>	<i>cm.</i>		<i>cm.</i>	<i>cm.</i>
Initial measurement	15	7.30	—	6	6.58	—
1	15	8.56	1.26	6	8.21	1.63
2	21	9.54	0.98	9	8.44	0.23
3	21	10.54	1.00	11	8.88	0.44
4	19	11.71	1.17	11	10.77	1.89
5	18	12.95	1.24	9	12.10	1.33
6	15	13.86	0.91	9	13.25	1.15
7	13	14.42	0.56	9	14.11	0.86
8	13	14.88	0.46	9	14.83	0.72
9	11	15.59	0.71	8	15.62	0.79
10	11	15.81	0.22	8	16.06	0.44
11	10	15.95	0.14	8	16.06	0.00
12	8	16.12	0.17	8	16.12	0.06
13	8	16.56	0.44	7	15.92	-0.20
14	8	16.87	0.31	7	16.07	0.15
15	7	17.07	0.20	7	16.07	0.00
16	7	17.14	0.07	6	16.08	0.01
17	7	17.17	0.03	5	16.10	0.02

TABLE 5

Showing the average monthly measurement and increase in width of rump of kids in lots I and II

AGE	LOT I			LOT II		
	Number measured	Average measurement	Average increase	Number measured	Average measurement	Average increase
<i>months</i>		<i>cm.</i>	<i>cm.</i>		<i>cm.</i>	<i>cm.</i>
Initial measurement	15	6.00	—	6	5.33	—
1	15	6.93	0.93	6	6.76	1.43
2	21	7.66	0.73	9	7.37	0.61
3	21	8.74	1.08	11	8.22	0.85
4	19	10.13	1.39	11	9.30	1.08
5	18	10.98	0.85	9	10.46	1.16
6	15	11.73	0.75	9	11.01	0.55
7	13	12.15	0.42	9	11.72	0.71
8	13	12.57	0.42	9	12.05	0.33
9	11	13.04	0.47	8	12.43	0.38
10	11	13.36	0.32	8	12.50	0.07
11	10	13.56	0.20	8	12.50	0.00
12	8	13.50	-0.06	8	12.50	0.00
13	8	13.81	0.31	7	12.57	0.07
14	8	13.87	0.06	7	12.92	0.35
15	7	13.85	-0.02	7	13.07	0.15
16	7	14.07	0.22	6	13.08	0.01
17	7	14.07	0.00	5	13.30	0.22

TABLE 6

Showing the average monthly measurement and increase in heart girth of kids in lots I and II

AGE	LOT I			LOT II		
	Number measured	Average measurement	Average increase	Number measured	Average measurement	Average increase
<i>months</i>		<i>cm.</i>	<i>cm.</i>		<i>cm.</i>	<i>cm.</i>
Initial measurement	15	30.06	—	6	29.25	—
1	15	33.43	3.37	6	33.41	4.16
2	21	38.00	4.57	9	37.32	3.91
3	21	41.64	3.64	11	41.77	4.45
4	19	45.98	4.34	11	43.86	2.09
5	18	49.64	3.66	9	47.98	4.12
6	15	52.10	2.46	9	50.22	2.24
7	13	53.26	1.16	9	51.72	1.50
8	13	55.50	2.24	9	52.94	1.22
9	11	57.86	2.36	8	54.43	1.49
10	11	58.95	1.09	8	55.12	0.69
11	10	59.85	0.90	8	55.43	0.31
12	8	60.43	0.58	8	55.75	0.32
13	8	60.87	0.44	7	56.07	0.32
14	8	61.06	0.19	7	57.28	1.21
15	7	62.14	1.08	7	57.50	0.22
16	7	62.78	0.64	6	58.66	1.16
17	7	64.28	1.50	5	59.20	0.54

TABLE 7

Showing the average monthly measurement and increase in circumference of barrel of kids in lots I and II

AGE	LOT I			LOT II		
	Number measured	Average measurement	Average increase	Number measured	Average measurement	Average increase
<i>months</i>		<i>cm.</i>	<i>cm.</i>		<i>cm.</i>	<i>cm.</i>
Initial measurement	15	30.13	—	6	29.41	—
1	15	33.93	3.80	6	33.41	4.00
2	21	42.68	8.75	9	41.44	8.03
3	21	49.48	6.80	11	48.38	6.94
4	19	55.43	5.95	11	52.86	4.48
5	18	61.17	5.74	9	59.66	6.80
6	15	63.03	1.86	9	61.11	1.45
7	13	63.84	0.81	9	62.44	1.33
8	13	67.00	3.16	9	64.87	2.43
9	11	69.09	2.09	8	64.87	0.00
10	11	70.81	1.72	8	65.25	0.38
11	10	70.85	0.04	8	65.87	0.62
12	8	69.00	-1.85	8	65.75	-0.12
13	8	69.06	0.06	7	68.14	2.39
14	8	68.93	-0.13	7	70.71	2.57
15	7	71.57	2.64	7	72.21	1.50
16	7	75.28	3.71	6	75.41	3.20
17	7	77.57	2.29	5	77.20	1.79

PUBLISHED CONTRIBUTIONS OF THE COLLEGE OF AGRICULTURE: VI¹

B. M. GONZALEZ
Dean, College of Agriculture

With the publication of this number of *THE PHILIPPINE AGRICULTURIST*, the College of Agriculture will have completed twenty years of service to Philippine agriculture and world science. In going over the titles listed herein, as well as those published heretofore, one cannot but realize that the field of Philippine agriculture has been extensively covered. A survey has been made, as it were, of the Philippine territory, which serves three utilitarian purposes; the intrinsic value of the work reported; the ground work it furnishes for a more intensive attack; and the knowledge it has made available to the world as the Philippine contribution to the sum total of world agricultural knowledge. The years that will follow will naturally see a more intensive investigation of certain phases of the area surveyed.

That the College has acquitted itself well in the field of its endeavors cannot but be admitted. The work of the College reported mainly in *THE PHILIPPINE AGRICULTURIST* stands as one of the most valuable collections existing on the agriculture of a tropical country. This published material constitutes a veritable monument to the founder and first dean of the College, Dr. Edwin Bingham Copeland, and his worthy successor the late dean, Professor Charles Fuller Baker, who nurtured and encouraged the spirit of inquiry from the early beginnings of the institution. This policy is now bearing its fruits fully.

The College is about to start on its third decade of existence. Its administration is now almost entirely in the hands of its first students who imbibed the spirit from the early masters. The policy of stimulating research will therefore be continued, and if it were possible, it will be given even a greater push.

II: EXPERIMENT STATION CONTRIBUTIONS

The contributions are numbered serially as reported. For Nos. 1-199, see *THE PHILIPPINE AGRICULTURIST* XII, No. 7, December, 1923. For Nos. 200-287 see *THE PHILIPPINE AGRICULTURIST* XIII, No. 10, March, 1925. For Nos. 288-354, see *THE PHILIPPINE AGRICULTURIST* XIV, No. 10, March, 1926. For Nos. 355-440, see *THE PHILIPPINE AGRICULTURIST* XV,

¹General contribution from the College of Agriculture No. 215

No. 10, March, 1927. For Nos. 441-517, see THE PHILIPPINE AGRICULTURIST XVI, No. 10, March, 1928.

- (518) MENDIOLA, N. B. 1928. Important progress in sugar cane breeding in the Philippines. Cane: 15-18. *Fig. 1-4*. Published by The Provincial Carnival Association, Bacolod, Occidental Negros, Philippine Islands.
- (519) UICHANCO, LEOPOLDO B. 1928. How Luzon and Negros may help each other in the control of sugar cane pests. Cane: 46-52.
- (520) MONTINOLA, ERNESTO R. 1928. Earle methods *vs.* ordinary method of treating ratoons. Sugar News 8: 261-279.
- (521) GONZALEZ, B. M. AND J. P. ESGUERRA. 1927. Is a zebu-carabao hybrid possible? The Journal of Heredity 18: 545-547. *Fig. 1*.
- (522) VILLADOLID, DEOGRACIAS V. 1927. The rediscovery of *Inopsetta ischyra*, a rare species of flounder. Annals Carnegie Museum 17: 395-397. *Pl. XXXV; fig 1-2*.
- (523) VILLADOLID, DEOGRACIAS V. 1927. The occurrence of *Naobranchia occidentalis* on the Pacific Coast of the United States. Journal Washington Academy Science 17: 230-231.
- (524) VILLADOLID, DEOGRACIAS V. 1928. The flatfishes (Heterosomata) of the Pacific Coast of the United States. *Abstract in Stanford University Bulletin, Fifth series, No. 47: 11-18*.
- (525) See Circular No. 14.
- (526) See Circular No. 16.
- (527) MENDIOLA, NEMESIO B. 1928. A report on an agricultural investigation trip to Java, Federated Malay States, and Borneo. The Philippine Agriculturist 17: 3-23. *Fig. 1-5*.
- (528) FRONDA, F. M. 1928. The seasonal distribution of egg production: The normal egg production curve. The Philippine Agriculturist 17: 25-36. *Charts 1-2*.
- (529) PALISOC, ELEUTERIO. 1928. Comparative nutritive values of different salts of ammonium. The Philippine Agriculturist 17: 37-43.
- (530) DAVID, PEDRO A. 1928. Note: Introduced coffees lose resistance to the rust fungus *Hemileia vastatrix* Berkeley and Broome. The Philippine Agriculturist 17: 45-49.
- (531) LAVA, V. G. 1928. The application of the method of least squares to the determination of the relationship between cane yields and stools per hectare. Sugar News 9: 460-463. *Charts 1-2*.
- (532) See Circular No. 10.
- (533) RODRIGO, P. A. 1928. Studies on the correlation between the seed and straw production of some field legumes. The Philippine Agriculturist 17: 83-87.
- (534) ESPINO, RAFAEL B. 1928. Report on recuperative growth within a year of some plants injured by a typhoon. The Philippine Agriculturist 17: 89-93. *Fig. 1-7*.
- (535) SERRANO, JOSE A. 1928. A comparative study of the effect of copra meal and dried shrimps as supplements in rations for laying hens. The Philippine Agriculturist 17: 95-104. *Chart 1*.
- (536) MONDOÑEDO, MARIANO. 1928. A comparative study of corn and cassava as feeds for hogs: II. Ground corn *vs.* raw chopped cassava. The Philippine Agriculturist 17: 105-107.
- (537) GORDON, ALEXANDER. 1928. A gravity gate, or a simple self-closing gate. The Philippine Agriculturist 17: 117-123. *Fig. 1-6*.
- (538) ETORMA, SEVERINO B. 1928. Proximate analysis of some Philippine shellfish. The Philippine Agriculturist 17: 125-133. *Pl. 1*.
- (539) ORDOVEZA, RAMON C. 1928. The culture and cost of barit in Bay, Laguna. The Philippine Agriculturist 17: 137-147. *Fig. 1-4*.

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- (543) PANTALEON, FELICIANO T. 1928. Effects upon rice plants of changing the moisture content of soil. *The Philippine Agriculturist* 17: 173-185.
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- (547) CORTEZ, FELIPE. 1928. Gray spot, or blight of coconut. *The Philippine Agriculturist* 17: 223-242. *Pl. 1-3.*
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- (554) ROA, MANUEL A. 1928. A word of comment on Gordon's gravity gate. *The Philippine Agriculturist* 17: 319-321. *Fig. 1-2.*
- (555) PEÑA, MARCELO B. 1928. Corn production as affected by some common manures. *Abstract in The Philippine Agriculturist* 17: 323-324.
- (556) ROXAS, M. L. 1928. Sugar cane varieties. Cane: 19-30, *Charts 1-2*. Published by the Provincial Carnival Association, Bacolod, Occidental Negros, Philippine Islands.
- (557) DE PERALTA, FERNANDO. 1928. Third list of cyanophoric plants of Maquiling region. *The Philippine Agriculturist* 17: 333-335.
- (558) LAVA, V. G., AND E. D. HEMEDES. 1928. The behavior of the antimony electrode in buffered and unbuffered solutions. *The Philippine Agriculturist* 17: 337-349. *Charts 1-2.*
- (559) VELMONTE, JOSÉ E. 1928. Philippine farmer's tax guide. *The Philippine Agriculturist* 17: 351-359.
- (560) FANDIÑO, J., AND F. BUENO. 1928. A study on the growth of coconut. *The Philippine Agriculturist* 17: 361-366. *Chart 1.*
- (561) BOLIVAR, SALVADOR F. 1928. A study on the preparation of hog ration as related to growth and development of pigs. *The Philippine Agriculturist* 17: 367-380. *Chart 1.*
- (562) PEGIÑA, JUAN. 1928. The effect of borders in farm crops experiments. *Abstract in The Philippine Agriculturist* 17: 383.

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- (582) ADRIANO, F. T. 1929. The use of steam in Kjeldahl nitrogen determination. The Philippine Agriculturist 17: 509-510. Fig. 1-2.
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- (585) MERCADO, TORIBIO. 1929. Sugar cane breeding in the College of Agriculture V: Isolation of live cane arrows and their use for hybridization. The Philippine Agriculturist 17: 527-535 Fig. 1-2.

- (586) PALLER, ENRIQUE M. 1929. The effects of dry heat on weevils in corn and on corn seed. *The Philippine Agriculturist* 17: 537-549. *Fig. 1-2.*
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- (590) GORDON, ALEXANDER. 1929. A summary of studies on the depth of irrigation water for lowland rice in western Laguna. *The Philippine Agriculturist* 17: 579-592. *Chart 1.*
- (591) MONTEMAYOR, ZOSIMO. 1929. A promising cassava grater for the farm. *The Philippine Agriculturist* 17: 593-597. *Fig. 1-2.*
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- (594) LIMPIADO, LEONCIO M. 1929. A comparative study of the growth and development of kids of milking and non-milking does. *The Philippine Agriculturist* 17: 625-634. *Charts 1-2.*
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III. GENERAL CONTRIBUTIONS

The contributions are numbered serially as reported. For Nos. 1-104, see *THE PHILIPPINE AGRICULTURIST* XII, No. 7, December, 1923. For Nos. 105-141, see *THE PHILIPPINE AGRICULTURIST* XIII, No. 10, March, 1925. For Nos. 142-164, see *THE PHILIPPINE AGRICULTURIST* XIV, No. 10, March, 1926. For Nos. 165-184, see *THE PHILIPPINE AGRICULTURIST* XV, No. 10, March, 1927. For Nos. 185-203, see *THE PHILIPPINE AGRICULTURIST* XVI, No. 10, March, 1928.

- (204) GONZALEZ, B. M. 1928. Vocational education. *The Philippine Agriculturist* 17: 1-2.
- (205) MENDIOLA, N. B. 1928. Some possibilities in breeding peanuts used for cover, green manures, and shade. *The Philippine Agriculturist* 17: 159-161.
- (206) GONZALEZ, B. M. 1928. Doctor Manuel L. Roxas: An appreciation. *The Philippine Agriculturist* 17: 197.
- (207) FRONDA, F. M. 1928. A review: "Practical poultry-farming". *The Philippine Agriculturist* 17: 201.
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- (209) SANTOS, F. O. 1928. The Japanese Imperial Institute for nutrition. *The Philippine Agriculturist* 17: 215-221.
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- (211) GONZALEZ, B. M. 1928. The role of the College of Agriculture in a system of vocational agricultural education for the Philippines. *Philippine Journal of Education* 9: 116-117.

- (212) SACAY, FRANCISCO M. 1928. An age of insects, not of man: Some notes on the fourth international congress of entomology. *The Philippine Agriculturist* 17: 381-384.
- (213) MENDIOLA, N. B. There is no crisis in personnel of College of Agriculture. *The Philippines Herald*, September 30, 1928.
- (214) SANTOS, ADRIANO. 1929. A review: "Commercial Timber Trees of the Malay States." *The Philippine Agriculturist* 17: 551.
- (215) GONZALEZ, B. M. 1929. Published contributions of the College of Agriculture: VI. *The Philippine Agriculturist* 17: 635-640.
- (216) GUANZON, G. 1929. Note: The Association of Junior Sugar Technology. *The Philippine Agriculturist* 17: 643-644.

IV. CIRCULARS

The circulars are numbered serially as reported. For Nos. 1-5 see *THE PHILIPPINE AGRICULTURIST* XIV, No. 10, March, 1926. For Nos. 6-11, see *THE PHILIPPINE AGRICULTURIST* XV, No. 10, March, 1927. For Nos. 12-14, see *THE PHILIPPINE AGRICULTURIST* XVI, No. 10, March, 1928.

No. 15.—Villegas, Valente. 1928. Cattle raising under Philippine conditions. (See Experiment Station No. 514).

No. 16.—Sacay, Francisco M. 1928. A simple farm record for the farmer.

NOTE: THE BAKER MEMORIAL PROFESSORSHIP

A professorship in memory of Charles Fuller Baker, who was dean of the College of Agriculture from 1917 until his death in July, 1927 has been definitely established by the Board of Regents.

In September, 1927 Dr. B. M. Gonzalez, Dean of the College of Agriculture recommended to the Board of Regents that the salary of Dean Baker, ₱9,000 (\$4,500), be continued indefinitely for the financing of a chair to be designated as the C. F. Baker Memorial Professorship in Agriculture. In presenting reasons for this recommendation Dean Gonzalez stated that, "The benefits that will accrue to our faculty from the very intimate contact with a new intellectual leader every year will be tremendous. These men coming from abroad with the latest ideas on their subjects will also bring to our work a new point of view which cannot but be beneficial."

The Board of Regents in establishing the professorship makes the conditions that "₱6,000 (\$3,000) of the amount will be used as salary for the incumbent, who shall be in residence in the College for not less than eight months and who shall carry a teaching load of not less than five hours a week". The Board set aside the remaining ₱3,000 (\$1,500) "to cover the travel expenses of the incumbent from his home to the Philippines and for his return. Whatever remains of the ₱3,000 shall be available to him for travel within the Islands.

It is realized that the salary this memorial professorship carries is wholly inadequate to secure the services, for the short period of a year, of men qualified to be of value to the College. It is hoped, however, that it is enough to secure men who are on sabbatical leave, or who for the experience and opportunity for study and observation in the Philippines for a year would welcome an appointment which carries at least full expenses both for travel and living.

The Los Baños region has been pronounced by botanists and zoölogists of wide experience to be one of richest and best known biotic groups in the world. For agronomists interested in the tropics the Philippines has much to offer. Also, the privilege of working in what is perhaps the best equipped Agricultural College in the orient should be an inducement;—to this privilege is added the convenience of the laboratories and scientific libraries in Manila.

For the faculty of the College and for groups of advanced students in the line of each man's specialty, the advantages of this professorship cannot be estimated. Infusion of new ideas or new presentation of old is quite as beneficial in an institution as infusion of new blood in animals. The presence each year on the Campus of a man from another institution, one who is a recognized authority in his line will be an inspiring influence, especially for our men who are engaged in research. For these men from abroad will bring to the College their knowledge enriched by experience, the enthusiasm that a new field always arouses; fresh interest in this very new country,—and above all each will come fired with a zeal to make his stay in the College of real worth.

In establishing the Baker Memorial Professorship the Board of Regents has paid a fine tribute to a man who gave to the College and the country service of worth beyond calculation; and has opened a possibility for benefit to the College of Agriculture that cannot be visioned.

EL HERBARIO, PROFESOR CHARLES FULLER BAKER

RESOLUCIÓN

POR CUANTO: En 22 de Julio de 1927 falleció en las Islas Filipinas el eminente Botánico y Biólogo Sr. Charles Fuller Baker, Dean de la Universidad de dicho Pais, el que prestó por espacio de largo tiempo valiosos servicios a la República en la recolección, estudio y clasificación de su Flora, fundando el magnífico Herbario que posee la Estación Experimental Agronómica de Santiago de las Vegas y restaurando el Herbario "Sauvalle" propiedad de la Academia de Ciencias, de cuya institución era Miembro Correspondiente,

POR CUANTO: El Director de la Estación Experimental Agronómica citada, a solicitud del Sr. Miguel Zarragostia, ha propuesto como medio de perpetuar su memoria que se dé su nombre al Herbario de dicho establecimiento,

POR CUANTO: En uso de las facultades que me están conferidas,

RESUELVO:

Primero: Disponer que se dé el nombre de "Profesor Charles Fuller Baker" al Herbario existente en la Estación Experimental Agronómica que con tanto saber y diligencia fundó y contribuyó a enriquecer el eminente sabio de este nombre; y comisionar al señor Director del citado Establecimiento para que notifique esta resolución a sus familiares, por conducto de la Universidad de las Islas Filipinas.

Segundo: El Sr. Subsecretario del Rama queda encargado del cumplimiento de la presente.

Dada en la Habana a veinticinco de Octubre de mil novecientos veintiocho.

DR. E. MOLINET,
Secretario de Agricultura, Comercio y Trabajo.

—*Revista de Agricultura, Comercio y Trabajo, (Habana, Cuba).*

[Translation]

THE CHARLES FULLER BAKER HERBARIUM

RESOLUTION

WHEREAS on July 22, 1927, death claimed in the Philippine Islands the eminent botanist and biologist, Charles Fuller Baker, dean in the University of that country, one who for a long time rendered valuable service in the (Cuban) Republic in the collection, study and classification of its flora, founding the magnificent herbarium of the Agricultural Experiment Station of Santiago de las Vegas and restoring the Sauvalle Herbarium of the Academy of Sciences, of which organization he was a corresponding member;

WHEREAS the director of the aforementioned Agricultural Experiment Station, at the instance of Sr. Miguel Zarragostia, has proposed, as a means of perpetuating Dean Baker's memory, that the herbarium of that institution be named after him;

THEREFORE, in the exercise of my legal powers,

IT IS RESOLVED:

First that arrangements be made that the name of Charles Fuller Baker be given to the herbarium of the Agricultural Experiment Station, which the eminent savant by that name founded and helped enrich with such knowledge and diligence; and that the director of that institution be commissioned to bring this resolution to the attention of his colleagues, through the University of the Philippines;

Second that Mr. Subsecretary del Rama is hereby entrusted with carrying out this resolution.

Given at Habana this twenty-fifth day of October nineteen hundred and twenty-eight.

DR. E. MOLINET,
Secretary of Agriculture, Commerce and Labor.

NOTE: THE ASSOCIATION OF JUNIOR SUGAR TECHNOLOGISTS

If one not familiar with the College of Agriculture should visit the campus in January or February, his attention will be attracted to a peculiar College building bearing in large letters the name "U. P. Sugar Mill." Curiosity may lead him to its interior where he will see not a lecturer before a class but embryo Sugar men at work on their first lesson in making centrifugal sugar from sugar cane. These students are the "Sugar Techs". In October 1922 under the guidance of Professor Henares the students in this course organized the Association of Junior Sugar Technologists, a vest-pocket edition of the Philippine Sugar Association.

The primary object of this association, of course, is to learn how to produce the best grade of cane sugar in maximum quantity. Even as sugar is used in various ways in various places, the "Sugar Techs" vary their activities. It is no exaggeration to say that the completion of the construction of the U. P. Sugar Mill in 1922 would have been much delayed had it not been for the help rendered by the "Sugar Techs". Besides working in the mill without compensation, the members of the association voluntarily worked to raise funds by cine benefits to give the finishing touches to the mill.



A NIGHT IN ALCHEMY

Staged by the Junior Sugar Technologists, College of Agriculture, August 18, 1928.

This was the first noteworthy act of the association. The first drama on a scientific subject ever written and presented in the College of Agri-

culture was by the "Sugar Techs." This memorable production, "In the Kingdom of the Sugar Technologists" was staged on August 13, 1925, on the lawn in front of the Sugar Mill. The latest dramatic stunt of the society was the celebration of Sugar Tech Day with a program on August 18, 1928, in the College Auditorium and with a dance at the Philippine Columbian Club, Manila, in the evening of August 25. Dr. Manuel L. Roxas was the guest of honor. Among the features of the program were a vocal solo by Miss Raquel Abelardo of the Conservatory of Music, "Discovery Announcement of the Newest Element (Woman, Wo)" by E. Sitchon, an illustrated lecture on an unpatented invention, "Science Has Cured Sleepiness in the Classroom", by W. Pangan; and remarks by Dean Gonzales in which he laid emphasis on the importance in this country of the Sugar Technology course. The novel feature of the evening was a chemical pageant, "A Night in Alchemy," written by R. D. Billinger and published in the *Journal of Chemical Education*.

The pageant was an excellent portrayal of the wonders of alchemy. The sudden appearance on the darkened stage of a luminous human skull; the production of fire from ice and water; the discovery of the secret messages of the builders of the great Egyptian pyramids; and the appearance of the famous Cleopatra's serpent from a piece of crayon gave the mystified audience something which held them breathless in wonder and suspense.

The cast was composed of:

Subtle, an Alchemist.....	Julian Gomeri
Lungs, the Alchemist's valet.....	Francisco Gomez
Gobbo, a wanderer who also practices the black art.....	Cayetano Ramos

The officers of the Association for the College year are: President, Enrique Hemedes; Vice-President, Manuel Hollero; Secretary-Treasurer, Ernesto Jamora; Athletic Manager, Cornelio Lemonecito; Editor, Rafael Rotor; and Faculty Adviser, Dr. Vicente G. Lava.

The importance of being a "Sugar Tech" is keenly realized by many aspiring students from all parts of the Islands, as is shown by the increasing number of applicants for the course every year. Also, several graduates from the general course have taken the courses in Sugar Technology, thus practically converting it into a sort of a post-graduate course. The need for Sugar Technology in this College is further demonstrated by the fact that all the "Sugar Tech" graduates are employed in sugar centrals in Negros or Luzon. Moreover, the Sugar Technology Division was asked this year to fill nine more technical positions in sugar centrals than there were graduates from the course.

Attraction for the course has been further augmented by the Bailonde la Rama scholarship which is effective in 1929. This scholarship is for the best "Sugar Tech" selected by competitive examination. Julian Gomeri a sophomore won the first of these scholarships.

G. GUANZON,

Of the Department of Agricultural Chemistry.

ABSTRACT¹

A *Fusarium* bulb rot of onion. ENRICO B. GAMO. (*Thesis presented for graduation from the College of Agriculture No. 284; Experiment Station contribution No. 595*).—The author describes the *Fusarium* bulb rot of onion that was first noted in the College Experiment Station at Los Baños in 1925. Much damage from the same cause was said to have been noted in one of the onion fields of Batangas. The disease is said to be due to a fungus which resembles in many ways *Fusarium udum* (Berk.) Wr., a saprophytic species, of the Section Eupionnotes. Externally, the diseased plant manifests rapid drying of the leaves from the tips. Then the bulb becomes soft and eventually rots. The fungus penetrates intracellularly into the host tissues. The mycelium is granular, vacuolate while young, but empty when old. The septate conidiophores produce conidia at their tips. The macroconidia are typically dorsiventral, generally 3-septate, and hyaline with slight tinge of green. The microconidia are nearly pear-shaped to ellipsoidal, non-septate, and hyaline tinged with slight green. Upon germination, the macro- and microconidia each produces two germ tubes—one at the hilum and another at the apical end. In culture true pionnotes are formed. The chlamydospores may be intraconidial, terminal, or intercalary. The intraconidial and terminal chlamydospore are borne singly. The former are abundant, spherical, and produce germ tubes on germination. The latter are of rare occurrence. The intercalary chlamydospores are borne either singly or in chains. The expressed onion juice prevents the germination of the spores of the fungus. Experiment with “sick soil” and damp-chamber inoculations manifested that the *Fusarium* onion bulb rot may infect Bombay and Tagalog onion varieties. The fungus may be disseminated by man and animals—in decaying plant materials, debris, and soil. Crop rotation, curing, and storing in cool, dry chambers are recommended for the control of *Fusarium* bulb rot of onion.

—Abstract by Pascual Robin.

EXCHANGE NOTES

One of the most active club boys in Iowa is Fred Schneider of Goodell. Fred has a record that is envied by many, and in reading it, it sounds like an American Magazine story. This is Fred's story:

“I have been a member of the Hancock Baby Beef Club for five years. I have always had good success with my calves and last year my calf won

¹ Abstract prepared as part of required theme work in English 6, College of Agriculture.

grand championship at our county fair. During this time I have attended the Club Congress at Chicago and have twice attended the Junior Short Course at Ames. I have also been on the judging team for two years.

"Club work is a wonderful thing and has helped me in many ways. I think one of the best results of club work is that it teaches you to take defeat as well as victory. This will mean much in later life, as one must meet with both. This is my last year in club work. Next year I expect to enter college. My experience in club work will benefit me very much there. Club work not only gives one the working side of life, but also the social side. There are club tours, trips and other events where you become acquainted with other people and learn their ways and that is what makes success—using other ideas with your own.

"It takes a lot of time, work and patience to succeed, but in the end you will see the good of it and it prepares you for the future with a clearer view of life and a more determined personality.

"There are many ways in which club work can be improved, but time will solve these difficulties. Good leadership, hard work and encouragement will keep it going and keep it doing its job of preparing young folks for future citizens."

—*Iowa Agriculturist* (Iowa).

Vitamins have not as yet been chemically identified, but it has been found that they are essential to normal growth and maintenance.

Vitamin A.—Fat soluble and necessary for growth, found in butter, milk, liver, codliver oil, and leafy vegetables such as cabbage, spinach, etc., also in egg-yolk, carrots, kidneys.

Vitamin B.—Water soluble, prevents Beri-Beri, found in yeast, dried beans, fruits, egg-yolk, peas, nuts, whole grain cereals, vegetables, milk.

Vitamin C.—Prevents scurvy; found in oranges, lettuce, tomatoes, green peas, spinach, cabbages, potatoes.

Vitamin D.—or Calcium-depositing vitamin, prevents Rickets—it is found in cod-liver oil, cocoa-nut-oil, shark-oil.

—*Farming in South Africa.*

A party of American soil experts and representatives of fertilizer interests visited Europe the past summer to see what Europe was doing in the fertilizing field. Following is their summary of what they saw:

Europe is a treasure house of valuable and interesting information, historically and practically. Historically, because it is the birthplace of soil science and has played so large a part in its development; practically, because it has shown the way, on fields that have been under cultivation

for more than two thousand years, to the upbuilding of a superior soil fertility as indicated by crop yields far surpassing those on our own practically virgin land.

—*The Fertilizer Review* (Washington, D. C.)

Long dry weather, when the ground becomes infested with droppings, is conducive to the outbreak of different diseases [among fowls], and there is generally a good crop of yaws and "fowl sick." Keep Epsom salts going in the water and Permanganate of Potash. The Epsom salts need not be given every day, but every third day, the Permanganate of Potash meanwhile. . . . When fowls are once attacked by what is called "fowl sick" it is hardly any use trying to treat them, and even if a fowl is treated, and an occasional one recovers, it is not much use afterwards. The first symptoms of "fowl sick" are, the fowl gets off the roost late, it sits in a corner and refuses food, and gradually dwindles away. When these symptoms occur, it is far better to kill the fowls than to try to treat them, or let them stay until they die.

—*The Journal of the Jamaica Agricultural Society.*

People of the United States are now consuming about 4.36 pounds of cheese per capita annually as compared with 3.5 pounds in 1921, according to the United States of Agriculture. In Switzerland the per capita consumption is approximately 23 pounds; in France, Denmark and the Netherlands approximately 13 pounds; in Germany 9.5 pounds; and in Great Britain 8.9 pounds.

—*The Prairie Farmer.*

In Kashmir State, located at the extreme border of northwestern India, even in this age of modern transportation a cart frequently is pulled more cheaply by a half-dozen men than by a pair of oxen or horses. Embracing an area of 84,258 square miles, it lies among the Himalayas, the great central range of which divides it into two parts.

—*Commerce Reports* (U. S.)

It costs less to cultivate a fertile soil than it does an infertile one. The total cost of raising the crop may be slightly higher due to the increased cost of harvesting but the cost per bushel or unit is much less for a crop of high yield than for a crop of low yield.

—*California Cultivator.*

The Bridal Orange Blossoms: Origin of Custom

When Spain was at the height of her power, a Moorish chieftain, wishing to curry favor with the Spanish monarch, sent him with all pomp and ceremony an orange tree as an emblem of fruitfulness and sincerity.

The French ambassador at the Spanish court, an astute statesman, hearing of these wonderful trees, and how quickly the fruit grew on them, desired to possess one. He discovered that, unknown to her father, the daughter of the royal gardener—a pretty, dark girl—was deeply in love with a young man, who, however, was comparatively poor, so that they could not marry.

The French noble, fearing that an attempt to bribe the gardener might be unsuccessful, approached the daughter, telling her that if she could obtain a small plant for him, he would give her a large sum of money. The girl assented, and when the plant was handed to the ambassador he paid her so liberally that the lovers were able to marry and purchase a farm for themselves. On her marriage day, the happy bride entwined orange blossoms in her hair in remembrance of her good fortune.

The Frenchman sent the plant to his estate in the south of France. In due course of time he was able to present a tree to the King of France, and a little later one was introduced into the Royal Garden of England.

When the story of the Spanish girl came to be known, the flowers began to be used as bridal wreaths and decorations, but for a long time they were so expensive that only the wealthy could indulge in their use.

Thus reads the story of the origin of the Orange Blossom Wreath worn at weddings.—*A. L.*

—*The American Florist.*

COLLEGE AND ALUMNI NOTES

Mr. William Thompson, popularly known as "Pussy-foot" Johnson, a modern crusader for world-wide prohibition, addressed the Student Body on January 10.

Anastacio L. Teodoro, B. Agr. '18, who, as government pensionado, has been studying in the United States for past two years has returned to the College. Mr. Teodoro studied in Cornell University, majoring in mechanical engineering. He received the degree of Doctor of Philosophy in June, 1928.

Before returning home, Doctor Teodoro traveled in Cuba, England, France, Belgium, Germany, Switzerland, and Italy with mechanical engineering as his special object of observation. From Europe he returned to the Philippines via Suez.

Doctor Teodoro was appointed Acting Head of Department of Agricultural Engineering on his return to the College.

Poultry Raising by F. M. Fronda, in charge of the Poultry Division in the Department of Animal Husbandry, is just off the press. Doctor Fronda

has written a practical text book of 269 pages to which the 69 illustrations add attractiveness. The book should be invaluable as a text in Philippine farm schools and as a guide for the individual poultryman. The Oriental Commercial Company, Inc. of Manila is the publisher.

The Los Baños Biological Club held its fortieth scientific meeting in the College Auditorium on December 13, 1928.

The following papers were read and discussed.

Ancestry of important College seedling cane varieties as suggested by Jeswiet characters.

By Dr. N. B. Mendiola.

Studies on the development of *Cercaria dorsocauda*.

By Dr. M. A. Tubangui.

Observations made on some coconut plantations in the Visayas.

By Mr. M. M. Kalaw.

The U. P. Sugar Mill started milling on January 15, 1929.

The following Sugar Technology seniors are now working in Sugar Centrals for their Mill Practice B (STech. 7):

Federico Isaac, in Pampanga Sugar Mills

Agustin Hermano, in Bacolod-Murcia

Enrique Hemedez, with Pampanga Sugar Development Co.

Agustin Luzuriaga, in Ma-ao Sugar Central

Ernesto Jamora, with Binalbagan Sugar Co.

Manuel Villano, in Pampanga Sugar Mills

Elias Eubanas, in Isabela Sugar Central.

The Christmas season was not gloomy for the students remaining on the Campus. One evening a group of about forty under the leadership of Miss Thuman and Miss Cole sang Christmas Carols in all the Student barrios, the Coconut Grove, in front of student bungalows, dormitories, "Y", faculty homes—both on lower campus and Faculty Hill. Singing Christmas Carols is a beautiful custom and it is hoped that the success of this first "Caroling" will lead to its repeating each year. The singing was good. As the music of old, old, well loved carols rang over the Campus, it brought to all, singers and listeners, the solemn sweetness of Peace on Earth, Good Will to Men.

A Christmas tree with a gay toys for each student, was the feature of the annual Christmas party given for the students by the faculty.

On Christmas night under the leadership of Rev. Hugh Bousman and Miss Cole about one hundred students had a jolly evening playing games in the Auditorium.

Mr. Francisco Palad, Assistant in Chemistry, was married to Miss Correa Adia of Urdaneta, Pangasinan, last December 26, 1928.

By request the Mimics repeated "The Twelfth Commandment" on the evening of January 12. The general verdict was that the cast surpassed their first very excellent performance.

On February 16 the Mimics closed a successful year with "The Cadets' Sweethearts"—a musical production written and arranged by Miss Anne F. Cole, the club director. This production was clever, jolly, altogether delightful and admirably presented. Centering around a big soccer football game with Manila U. P. team Cadet Songs, rally songs and all that goes with "pep rallies," gave a jolly bit of student life. The two pairs of sweethearts brought in the necessary "love element". And most skillfully were the old songs and old tunes with new words woven into a story of student life. From the opening scene with Captain José singing to violin accompaniment, the old classic "Believe me" to his sweetheart, Maria, as she broke through a huge red heart, to the closing scene—which was the double wedding (military) of Jose' and Maria, and Juana and Pedro, it was a charming gay bit. The wedding was told to audience by the familiar strains of Lohengrin March played back stage on an organ by Professor Roa. Then as the church doors opened to the strains of the Mendelssohn Wedding March came the two bridal couples under the traditional arch of crossed sabers. With Schuberts "Song of Love" by the Cadets and brides the curtain fell. Mention cannot be made of one scene, of one song—all were so well given, so well sung, both solos and choruses.

From every standpoint, in conception and construction and in presentation the play merits high praise.

And warm words of praise are due Mrs. Hugh Bousman, the musical director, for her splendid cooperation and generous giving of her ability.

THE CADETS' SWEETHEARTS

Written and arranged by ANNE F. COLE

(Many familiar songs used in whole or in part to help tell the story)

CAST OF CHARACTERS

José—Cadet Captain.....	Fernando Fernandez
Maria—His Sweetheart.....	Maria Villadolid
Pedro—His Chum.....	Honorio Ylizardo
Juana—Pedro's Sweetheart.....	Mamerta Manahan
Juan—José's Rival.....	Onopre Casupang
Francisco—Juan's Friend.....	Ruperto Ami
Antonio—Cadet Rooter King.....	Sabas Tangco
Julio—Clown of the Cadet Corp.....	Honorio Reyes
Primo.....	Loreto Rivera
Honorio.....	Valentin Amon
Leon.....	Vicente Fernandez
Angel.....	Domingo Tugade
Santos.....	Jacinto Antonio
Sebastian.....	Francisco Sipin
Gregorio.....	Hermenegildo Farolan
Felix.....	Eugenio Avanceña

"The Cadets' Sweethearts"—Overture

ACT I

Songs

(Minor songs not listed)

Believe Me If All those Endearing Young Charms - - - - -	José
Love is Just a Game - - - - -	Maria, José and Cadets
Juana, Juana, I've Been Thinking (Adapted) - - - - -	Juana and Pedro
Juan's Lament (Old tune) - - - - -	Juan
I Passed by Your Window (Adapted) - - - - -	Pedro
Stand Beneath Our Colors - - - - -	Cadets
The Game (Old tune) - - - - -	Angel
Good Bye Manila (Old tune) - - - - -	Antonio
The Love Nest - - - - -	Maria and Juana
I'd Love To - - - - -	Juana, Pedro and Cadets
Song of Love - - - - -	José, Maria and Cadets

CURTAIN

Medley—The Cadets' Sweethearts

ACT II

Just Been Wond'ring All Day Long - - - - -	Juana
It Takes a Girl to Do it Every Time (Old tune) - - - - -	Juana
They're Always Abusing The Women - - - - -	Juana
(Words from a Greek play by Aristophanes)	
Deep in My Heart, Dear - - - - -	José and Maria
And The Romance Ends Right There (Adapted) - - - - -	Honorio and Cadets
The Bachelor's Song of Freedom (Old tune) - - - - -	Julio and Cadets
Song of Love - - - - -	Grand Finale

INDEX

VOLUME XVII

JUNE, 1928 TO MARCH 1929

A

- Abacá investigation, 110
- ABBOTT, J. B., S. D. CONNER, AND H. R. SMALLEY, cited, 607
- ABESAMIS, A. P., cited, 174
- Abo, *see* *Johnius belengeri*
- Absentee landlords, 328
- Achimenes* sp., 22
- Acids
- amido, 565
 - nitric, 565
 - organic, 565
- Achras sapota*, 22
- ADAMS, FRANK, cited, 579
- ADRIANO, F. T. The use of steam in Kjeldahl nitrogen determination, 509
- ADRIANO, F. T., AND E. J. TAVANLAR, cited, 253
- AHRENS, B. A., cited, 103
- Albizia*
- chinensis*, 21
 - lebbek*, 90, 91
 - stipulata*, 21
- Aleurites moluccana*, 21
- Alimaño, 130
- Alimasag, crab, 126
- ALLAS, T. P., cited, 166
- ALLEN, E. W., cited, 367
- Allium cepa*
- A *Fusarium* bulb rot of, in the Philippines, 301, 647
 - causal organism of, 303
 - morphology, 304
 - mycelium, 304
 - pionnotes, 310
 - pot inoculation with, 311
 - proof of pathogenicity, 311
 - control of, 315
 - economic importance of, 302
 - history and geographical distribution of, 301
 - symptoms of, 302
- Aluminum
- a determining factor in soil acidity, 607
 - chloride, 607
 - harmful effects of, 612
 - ion, 607
 - nitrate, 608
 - salts
 - influence of concentration of, 612
 - toxicity of, 607
 - sulfate, 607, 608
- Amaranthus* sp., 22
- Ammonia, distillation of, 509
- Ammonium
- alum, 608
 - nitrate series, 38, 39
 - nutritive values of different salts of, 37
 - phosphate series, 38
 - salt series, best cultures from each of the, 40
 - sulfate series, cultures in, 40
- Ampullaria vittata*, 126, 127
- Anabas testudineus*, 255
- Anak-bat, 254
- Ananas comosus*, 22
- Anchovy, *Anchoria commersoniana*, 254
- Angitia punctoria*, 398
- Animals
- breeding, seasonal activities of, 477
 - Indian blood, 625
 - milking does, 625
 - non-milking mothers, 625
- Aninapla, *see* *Albizia lebbek*
- Association of Junior Sugar Technologists, note on, 645
- Ants, in German forests, valuable help, 383
- Apahap, *see* *Umbrina russelli*
- Arachis hypogaea*, 22, 83
- cuttings, germination and rooting of, 521
 - varieties
 - C. N. 3077, 86
 - Kinorales, 84, 86, 519
 - Lemery, 84, 86, 519
 - Spanish C. N. 3077, 84, 86
 - Tarlac, 86, 519
 - Zambales Lupog, 86
 - yield
 - pod, 522
 - straw, 522

- Arca granosa*, 128, 129
Aristolochia sp., 22
Arius spp., 254
Artocarpus
 integra, 22
 rigida, 22
 ASDELL, S. A., cited, 478
 Association, Japan Nutrition
 organization, 221
 source of income of, 221
 ATWOOD, HORACE, cited, 511
 Avian disease, contagious
 autopsy of birds affected by, 264
 symptoms of, 263
 transmission of, 264
 treatment, 261
 AYRE, E. E., cited, 165
 Ayuñgin, *see* *Pristopoma hasta*
- B**
- BABCOCK, S. M., mentioned, 269
 Baclaran poultry farm, 263
 BACON, C. A., cited, 488
 BAERG, W. J., mentioned, 383
 Bagoong, 254
 BAILEY, LIBERTY HYDE, mentioned, 211
 BAKER, C. F.
 cited, 223, 499
 coöperation, 115
 Dean, 4
 entomological collection, disposition of the,
 199
 memorial fund, 109
 mentioned, 476
 professorship, 641
 Bakoko, *see* *Sparus calamara*
 BALAGTAS, AMADO N. The chemical composition of Philippine fishes, 253
 Balakwit, *see* *Strobilus canarium*
 Banak, *see* *Mugil cephalus*
 Bandoeng, exposition at, 5
 Bangilan
 coffee estate, 14
 government coffee estate at, 5
 Bangelus, *see* *Chanos chanos*
 Baños, *see* *Chanos chanos*
 BANKS, CHARLES S., cited, 398
 Barit, *see* *Leersia hexandra*
 Barong, *see* *Pinna vista*
 Barred Plymouth Rock, 263
 BARRETT, O. W., cited, 223
 Bastard shad, *see* *Konosirus thrissa*
 BEHRENS, J., cited, 565
 Berk-Jalas, College bred, 105
 BERTUS, L. S., cited, 223, 225, 226, 230, 231, 232
 Besugo, *see* *Pomadasis argyreus*
 Biang-puti, *see* *Glossogobius giurus*
 Biang-sudsod, *see* *Platycephalus indicus*
 Bigatan, *see* *Arca granosa*
 Biña, *see* *Melo aethiopica*
 Birds, early, in experimental chicken, 514
 Bitubituin, 127
 BLISS, R. K., AND C. B. LEE, cited, 368
 BLOKZEIJL, K. R. F., cited, 593
 BOLIVAR, SALVADOR F. A study on the preparation of hog ration as related to growth and development of pigs, 367
 Bordeaux mixture for control of coffee rust, 79
 Botys
 lupulina, 397
 lupulinalis, 397
 nubilalis, 397
 silacealis, 397
 zealis, 397
 BRAUN, H., cited, 500
 BRITT, J. B. Vocational teacher of agriculture in North Carolina, 275
 Buan-buan, *see* *Megalops cyprinoides*
 Bubalus bubalis, 169
 Buffaloes, the trend of reproductive season of water, 482
 Buffer solutions, antimony electrode in, 337
 Bugaong, *see* *Therapon puta*
 Bugs, collection of, 200
 Buguing, *see* *Hemiramphus* sp.
 Buitenzorg, 4
 central rubber experiment station at, 16
 organization of the general experiment station at, 10
 tea experiment station at, 16
 BULIGAN, CATALINO T. The corn borer, *Pyrausta nubilalis* Hübner (Pyralidae, Pyraustinae, Lepidoptera), 397
 Bundaqui, *see* *Ophicephalus striatus*
 BUSCK, A., cited, 223
- C**
- Caesio, or dalagang-bukid, *see* *Caesio chrysozona*
Caesio chrysozona, 254
 CAFFREY, D. J., cited, 398
 CAFFREY, D. J., AND L. H. WORTHLEY, cited, 398
 Calendra
 granaria, 542
 oryzae, 537
Calopogonium muconoides, 21
 Caligay, snails, 127
 CALMA, VALERIANO C., LORENZO G. PADERNA, AND MACARIO A. PALO.
 A study of certain chemical treatments in relation to seed-borne diseases of Calauan Yellow Flint maize, 499
 Camot pusa, *see* *Circe gibba*

- Cane breeding garden at Blambagan, 5
 Cane breeding, Jeswiet hair groups in, 279
 Carabao
 Cooperia in, 169
 Indian buffalo, 478
 morbid anatomy of, 169
 native carabaos, 478
Caranx malabaricus, 258
 Carbon
 assimilation of, 608
 bisulphide, 537
 CARD, LESLIE E., cited, 511
 Carnivals, provincial, 51
 Cassava
 breeding of, 11
 grater, 593
 Cas-sisung, *see* *Scomberoides tol*
 CATAMBAY, ALEJANDRO B. Comparative wear of certain metals and alloys used in plows and disk harrows, 487
 cited, 26, 30
 Catfish, *see* *Clarias batrachus*
 Cattle
 Nellore and Hereford breeds, 478
 the trend of sexual reproductive seasons of, 480
 CAVANAUGH, GEO. W., mentioned, 510
Centrosema pubescens, 21
Cerithium verlagus, 126
Chanos chanos, 257
 Chicken
 scaly legs of, and control, 562
 weanling and yearling, 515
 weights of individual, 511
 White Leghorn, 512, 513
 Chickens, Cantonese, 263
 "Improved Los Baños", 560
 relative cost of feed used and of eggs produced by, 100
 Chicks, Cantonese, 512, 515
 mortality of, 102
 observation of, 97
 weight and growth of, 102
 CHITTENDEN, F. H., mentioned, 537
 Chloride and SiO₂, 566
Chrysobothris dentipes, 538
 Cigarettes
 alcohol extracts, 570
 American manufacture, 565, 569
 petuning substances in, 571
 comparative analysis of American and Philippine, 565
 extractable substances, 565
 Philippine, 565, 567, 569
 polyphenols in, 566
 Cinchona, 22
 plantations in Java, private, 18
Circe gibba, 129
Clarias batrachus, 255
 CLARK, W. MANSFIELD, cited, 339
 Climbing perch, *see* *Anabas testudineus*
 Coconut, *see* *Cocos nucifera*
Cocos nucifera
 a study on the growth of, 361
 brooms, 166
 brushes, 166
 bukayo, 164
 buko, 164
 coir fibers, 166
 drying problems in Leyte, 467
 endocarp of, 362
 endosperm of, 362
 flower, spathe of, 167
 gray spot, or blight of
 causal organism of, 223
 economic importance of, 223
 symptoms and signs of, 223
 hard shells of, 362
 husk, mops from, 166
 latek, 164
 leaves, palaspas from young, 163
 leaves for wrapping suman, 164
 mesocarp of, 364
 mops, 166
 products, chemical studies on, 163
 shell and husk, 166
 toddy, 167
 beverage from, 167
 palm sugar from, 167
 vinegar from 167
 twine, 166
 uses of nut, roots, trunk, and leaves of
 163, 164
 water, 166
Coffea spp.
 and rubber experiment station, Malang, 5, 16, 20
 beetles, 80
 berries, 77, 78
 Cercospora disease, 179
 commercial varieties, 14, 66
 crickets on, 80
 diseases and pests, 79
 distancing of, 72
 Hemileia vastatrix on, 79
 hybrids, 14
 improvements of, 14
 maximum production of quality, 65
 monkeys and cattle damage to, 80
 notes on yields of some species of, 317
 planting of, 65, 72
 plantation
 catch crop for, 77
 cultivation of, 76

- climate of, 66
 - elevation of, 65
 - estimate of opening one hectare of, 80
 - good land for, 65
 - holing, 72
 - liming, 72
 - preparation of, 72
 - proximity to river, 66
 - selecting land for, 65
 - shelter for wash and wind, 66
 - weeding of, 75
 - pruning, 76
 - resistance to the rust of, 45
 - scale insects on, 80
 - seed bed and nursery
 - location of, 68
 - planting in the nursery beds, 69
 - planting the seeds, 69
 - preparation of, 68
 - shading the beds, 69
 - seed selection and preparation of seeds for planting, 68
 - shade for, 73
 - transplanting of, 70
 - variety to plant, 67
 - watch dog for keeping, 80
 - Coffee, *see Coffea* spp.
 - COHN, ROBERT, cited, 165
 - Cohol, *see Ampullaria vittata*
 - College and alumni notes, 55, 113, 158, 209, 271, 329, 390, 470, 555, 648
 - College of Agriculture
 - class of 1928, 56
 - contributions of,
 - circulars, 640
 - experiment station, 635
 - general, 639
 - COLLINS, A. L., mentioned, 491
 - Congress
 - agricultural, the eighth, 386
 - International Entomological, importance of, 384
 - CONNER, S. D., AND O. H. SEARS, cited, 607
 - Consumer, taste of, 565
 - COOK, C. M., cited, 225
 - Coöperation, 115
 - Cooperia in carabao, 169
 - COPELAND, E. B., cited, 233, 361, 593
 - Copra cake, 165
 - Corn, *see Zea mays*
 - Corn and cassava as feeds for hogs, 105
 - CORTEZ, FELIPE. Gray spot, or blight of coconut, 223
 - Cover crop, 21, 51
 - Cowpea, *see Vigna sinensis*
 - Cucumber varieties, 84, 85, 86
 - CRAMER, P. J. S., mentioned, 4
 - Croaker, *see Johnius belengeri*
 - Crop
 - annual selection of, 4
 - farm, experiment, effect of borders in, 385
 - farm, production, selecting land for, 155
 - working of the sections for annual and perennial, 11
 - Crops, perennial, section for, 14
 - Crossing of varieties, 14
 - Crotalaria*
 - anagyroides*, 21
 - usaramoensis*, 21
 - CRUCILLO, CORNELIO V., cited, 95
 - CRUZ, H., cited, 289
 - CUZNER, HAROLD, mentioned, 593
 - Curves, probable irrigation, 583
 - Cutter, bolo, 187
 - Cyrena gigantea*, 123
- D
- Dalag, *see Ophicephalus striatus*
 - Dalagang-bukid, *see Caesio chrysozona*
 - DANGILAN, LUIS J., cited, 102
 - DAVID, PEDRO A.
 - Note: Introduced coffees lose resistance to the rust fungus, *Hemileia vastatrix* Berkeley and Broome, 45
 - Practical directions for coffee planting, 65
 - DEAN, GEORGE A., cited, 537, 539
 - DEAN RUSSEL, 4
 - DERECHO, ANTONIO, cited, 95
 - Diet
 - importance of fish in, 253
 - therapy, clinical division for, 216
 - Disks
 - Brinell hardness, 489
 - penetration, 488
 - DEAN, R. W., cited, 538
 - Does, non-milking, 625
 - DRAKE, C. J., cited, 422
 - Drepane, or mayang, *see Drepane punctata*
 - Drepane punctata*, 255
 - DRIBERG, C., cited, 255
 - Drum, *see Umbrina russelli*
 - DUGGAR, B. M., cited, 225
- E
- EALA, QUINTIN A., cited, 291, 293
 - Echocerus cornutus*, 535
 - Eclipse of May 9, 1929, 465
 - Education
 - agricultural, in the United States, 557
 - vocational, 1
 - Egg production, the seasonal distribution of, 25
 - distribution curves of, 26, 29
 - normal curve, 25

- percentage of, 25
- seasonal distribution of, 25
- varies with different seasons, 25
- EIDMAN, H. A., mentioned, 383
- Electrode
 - antimony in buffered and unbuffered solutions, behavior of, 337
 - preparation of, 338
 - theory regarding the behavior of, 342
 - non-gas, 337
- ELY, RICHARD T., cited, 288
- EMBODY, G. C., cited, 95
- Encarsia flavoscutellum*, 20
- ENERVA, EPIFANIO, cited, 102
- Ephesia kuehniella*, cited, 538
- Epicrisis, 170
- Erythrina fusca*, 46
- ESPINO, R. B., cited, 37
 - Report on recuperative growths of plants injured by typhoon, 89
- ETORMA, SEVERINO B. Proximate chemical analysis of some Philippine shell fish, 125
- Eulimneria crassifemur*, 398
- EVANS, ARTHUR T., AND M. FOWLDS, cited, 188
- EWING, P. V., AND E. R. SPENCE, cited, 166
- Exchange notes, 53, 111, 156, 208, 269, 327, 388, 468, 553, 647
- Extension division notes, 51, 110, 154, 203, 267, 325, 386, 467
- Extension service
 - of America, 269
 - relative importance of, 268
- F
- FARADAY, MICHAEL, 116
- FABELLA, JOSÉ, mentioned, 215
- FANDINO, J. BUENO F. A study on the growth of coconut, 361
- Farmer's future, 1
- Farmers, dirt, 326
- Federated Malay States, 5
- Feeds
 - concentrates, 627
 - dry mash, 512
 - grit, 512
 - oyster shell, 512
 - roughage, 627
- Fehling's solution, 566
- FELT, E. P., mentioned, 383
- Fields, 580
 - preparation of, 582
 - soil condition of, 492
- Fishery resources of the Philippine Islands. 254
- Fishes, Philippine
 - chemical composition of, 253
 - methods of analysis of
- ash, 259
- calorific value, 260
- carbohydrates, or nitrogen free extract, 260
- crude fats, 260
- crude fiber, 259
- edible portion, 259
- moisture, 259
- nutritive ratio, 260
- proteins, 259
- sampling, 259
- Flathead, *see* *Platycephalus indicus*
- Fleas, known species of, 382
- Flocks, egg records of, 26
- FLORIDA, VICENTE T. Variability in important agronomical characters among seedling canes from parent varieties H-227, Louisiana Striped, Cebu Purple, and Badila, *abstract by* JOSÉ O. CRUZ, 552
- Flounder, *see* *Pseudorhombus neglectus*
- Food, values of substitute, 216
- Forages for Philippine horses, selection of, 600
- FORBES, STEPHEN A., mentioned, 542
- Forest cleaning, 203
- FOSTER, M. Nature, 52
- Fourth International Congress of Entomology at Cornell University, 381
- Fowl, the Nagoya, a dual purpose, 559
 - foundation stock of, 560
 - Japanese standard for, 563
 - points in favor of, 563
 - plumage color of, 562
 - record of, 562
 - weakness of, 562
- Fowls
 - farm and Shanghai, 560
 - original homes of progenitors of present day breeds of domestic, 25
- FOXWORTHY, F. W., cited, 551
- FRANKE, KURT W., AND J. J. WILLAMAN, cited, 337
- Fresh water shrimps, *see* *Palaemon sunduicus*
- FRONDA, F. M.
 - A review: Practical poultry farming, 201
 - Accuracy in the weighing of experimental chickens, 511
 - cited, 26, 28, 103
 - The seasonal distribution of egg production: The normal egg production curve, 25
- FRONDA, F. M., AND B. M. GONZALEZ. The Nagoya, a new immigrant from Japan, 559
- FROMME, F. D., cited, 46
- Fruit extension garden in Pasoeroean, 5
- Fusarium*
 - cepae*, 301

oryzporum, 301
 sp. 501
vasinfectum, 301
zonatum, 301

G

GALLAGHER, WALLACE. The measure of a man, 116
 GALVEZ, N., R. MORENO AND V. G. LAVA. Chemical studies on coconut products: II. Utilization of the coconut, 163
 GAMO, ENRICO B. A *Fusarium* bulb rot of onions, abstract by PASCUAL ROBIN, 615
 Gaud-gaud, or porgy, see *Sparus calamara*
 Gas, cyanide, 537
 Gate, gravity, 117
 materials for construction of, 119
 methods of fastening and hanging, 119, 120
 principle of, 121
 GAY, CARL W., cited, 477
 Get it done, 214
 GIBBS, H. D., AND F. AGCAOILI, cited, 253
Gliricidia maculata, 46
Glossogobius giurus, 96, 256
Glycine
 hispida, 188
 max, 83
 Ami, 84, 86
 Otootan, 84, 86
 Goats
 dairies, 625
 Indian and Nubian grades, 478
 the trend of reproductive seasons of, 482
 Goby, see *Glossogobius giurus*
 GO KEE, FRANCISCO. Notes on an outbreak of poultry epidemic, 263
 GONZALEZ, B. M.
 cited, 361
 Doctor MANUEL L. ROXAS: An appreciation, 197
 Nagoya, the, a new immigrant from Japan, see FRONDA, F. M., AND B. M. GONZALEZ
 Published contributions of the College of Agriculture: VI, 635
 vocational education, 1
 GOMEZ, A. K. Pathological lesions caused by an undescribed *Cooperia* in a carabao, 169
 GOODWIN, W. H., cited, 538, 539
 GORDON, ALEXANDER
 A gravity gate, or a simple self-closing gate, 117
 A summary of studies on the depth of irrigation water for lowland rice in western
 Philippines, 579

Gordon's gravity gate, a word of comment on, 319
 GOSSARD, H. A., cited, 538
 GRAHAM, VERE, AND R. S. CARR, cited, 567
 Grater for cassava
 blades of, 596
 box and stand of, 596
 description of, 594
 results of trials of, 596
 wheel of, 595
 GREENLEAF, WALTER J., mentioned, 269
 Grunt, see *Pristopoma hasla* and *Pomadasis argyreus*
 Guinea grass, 600
 Gur and its prices in India, 270

H

HABERLANDT, C., cited, 458
Habrobracon brevicornis, 398
 Half-beak, see *Hemiramphus* sp.
 HAMMOND, W. A., mentioned, 381, 384
 Hands, farm, shortage of, 287
Hapalia
 kasmirica, 397
 lupulina, 397
Harengula moluccensis, 256
 Harrow, disk, 493
 methods of testing, 491
 Harrow, John Deere, 492
 HARTWELL, B. L., AND F. R. PEMBER, cited, 607
 Hasa-hasa, see *Scomber japonicus*
 Heat
 as a means of controlling mill insects, 538
 dry, effects of, on weevils in corn and on corn seeds, 537
 regulation and control of, 540
 Heating system, 537, 540
 HEINRICH, CARL. The main business of science, 331
 mentioned, 397
Helminthosporium inconspicuum, 503
 HELYAR, F. G. Short courses in Agriculture, 211
Hemilcia vastatrix, 45, 79, 317
 Hemorrhagic septicemia, 371
 HENRY, W. A., cited, 367
 Hens, Cantonese
 copra meal and dried shrimps for, 95
 egg production of, 97
 observations on, 97, 100
 mortality of, 101
 testing the fertility of the eggs of, 97, 101
 HERBERT, D. A., cited, 333
 HERRICK, GLENN W.
 cited, 538
 mentioned, 542
 Herring, see *Harengula moluccensis*

- Hevea rubber, 22
 HEYNE, K. Nuttige Planten van Nederlandisch Indie, 7
Hibiscus cannabinus, 22
 HINDS, W. E., AND H. SPENCER, mentioned, 380
 HIND, E. W., AND W. F. TURNER, cited, 539
 Hito, *see Clarias batrachus*
 Hog
 corn and cassava as feeds for, 105
 ration, a study on the preparation of, 367
 HOLBERT, J. R., AND G. M. HOFFER, cited, 499
 HOLBERT, J. R., C. S. REDDY, AND B. KOEHLER, cited, 500
 HOLONISKY, FRANZ, cited, 166
 Homesteaders, a valuable aid to, 326
 HORN, WALTER, mentioned, 383
 Horses, 599
 age of, 599
 American grade, 599
 Arabian infusion, 599
 breeding establishments of, 478
 calesa
 bathing of, 246
 concentrates given to, 244
 feeding of, 244
 grooming, 246
 native, 243
 relation of feed consumption to work done, 245
 roughages fed to, 244
 salting feeds for, 245
 scales for weighing, 244
 shoeing, 247
 stables for, 247
 trimming of mane and tail, and clipping of hair, 247
 watering, 245
 work performed by, 245
 heights of, 599
 native blood, 599
 Welsh blood, 599
 the trend of sexual reproductive seasons of, 480
 HOWARD, LELAND O., mentioned, 381
 HUBER, L. L., AND C. R. NEISWANDER, cited, 398
 HUMPHREY, C. J., note on, 329
 HURD, LOUIS M., mentioned, 201
 Hybrids, means of multiplication of important, 11
 Hydrogen ion in soils, 607
 Hydrogen ion concentration of different buffer solutions, 337

 I
 IMMS, A. D., mentioned, 382
 Import duties in the Philippines, 351
 INCIONG, ANTERO P. A study of the feeding, care, and management of native calesa horses, at Los Baños, Laguna, 243
 Income
 gross, 355, 357
 personal exemption from net, 357
 tax, 351
 calendar for farmers, 358
 forms, 359
 returns, 355, 357
Indigofera hendecaphylla, 21
 Insects
 age of, 381
 control of, 537
 Malayan, left by DEAN BAKER, 200
 of the upper air, 383
 species of, 382
 Insect pests, fumigant and heat as control of, 538
 Insect zoo in Paris, 270
 Insectary methods, 401
 Institute, Japanese Imperial Government, 215, 216
 equipment of, 218
 origin of, 215
 personnel, 217
 present investigations in, 220
 published work of, 219
 salaries, 218
 work of, 218
 International Education Board of New York, 3
 Invaders, foreign insect, 384
 Investigators in Java
 facilities for, and difficulties of, 5
 language preparation of, 5
 library of the department of agriculture for, 6
 location of main offices and laboratories, 5
 publications in Dutch, 6
Ips pini, 538
 Isabela region, 567
 Irrigation
 method of, 581
 water, 579

 J
 JANSEN, B. C. P., cited, 166
 JAOJOCO, FELIPE M., cited, 166
 Japanese mackerel, *see Scomber japonicus*
 Jardin des Plantes, 270
 Java
 experiment stations, 5, 9, 16, 21
 Department of Agriculture, Commerce and Industry of, 5, 7
 private stations in, 16
 school of agriculture in, 8

JEANNEL, Dr., 270
Johnius belengeri, 255
 JOHNSON, J. B., cited, 490
 JONES, C. R., cited, 393, 488
 JONES, JENKIN W., cited, 580
 JULIANO, J. B., cited, 333

K

Kabasi, *see* *Konosirus thrissa*
 Kahlbaum antimony metal powder, 338
 KALAW, MOISES M. Extension division notes, 267, 325, 467
 Kandule, *see* *Arius* spp.
 Kapok, Surinam, 22
 KAUPP, B. F., cited, 103
 KEGHIL, MAURICE DE, cited, 165
 KENNARD, D. C. AND P. S. WHITE, cited, 103
 KENNEDY, W. J., AND E. T. ROBBINS, cited, 368
 Kjeldahl nitrogen determination, 509
 Kids
 circumference of barrel, 630
 heart girth, 630
 height at withers, 630
 length of back and rump, 630
 width of rump, 630
 weighing and measuring of, 630
 weight, 630
 KING, W. J., cited, 85
 Kitang, *see* *Scatophagus argus*
 Klaten, Tobacco Experiment Station at, 5, 16
 KLOPPENBURG, C. A., cited, 166
 KOBAYASHI, K., cited, 165
 KOCH, L., mentioned, 4
 Kolapo, *see* *Glossogobius giurus*
 KOLTHOFF, I. M., AND B. D. HARTONG, cited, 337
Konosirus thrissa, 254
 KRATZMANN, E., cited, 608
 KRUPP, FRIEDRICH, mentioned, 491
 Kuala Lumpur, Department of Agriculture and Forestry in, 5
 Kulisic, *see* *Hemipterus japonicus*
 Kulisig, *see* *Nemipterus* sp.

L

Labor, agricultural
 distribution of, 288
 supply of, 288
 Labor problem solution, farm
 discourage emigration to Hawaii, 296
 improvement of roads, 298
 increase of wages and offer continuous work, 297
 Labor supply, conditions affecting farm
 absence of good roads, 295
 differences in wages, 293
 emigration to Hawaii, 291

geographical situation of country, 295
 school term coincides with working seasons, 295
 village system of government settlement, 295
 Laborers, exodus of Filipino, 291
 LA MER, V. K., AND T. R. PARSONS, cited, 341
 Lagohot, *see* *Pristopoma hasta*
 Land, delinquent, forfeited to government, 355, 357
 Langil, *see* *Albizia lebbek*
 LANGWORTHY, C. F., cited, 260
Lansium domesticum, 22
 Lapis, *see* *Scomberoides tol*
 LARSON, A. O., AND C. K. FISHER, cited, 538
 LAVA, V. G., AND E. D. HEMEDES. The behavior of the antimony electrode in buffered and unbuffered solutions, 337
 LAVA, V. G., AND S. B. ETORMA. Comparative analysis of American and Philippine cigarettes, 565
 Laying year for chickens, 27
 Leather Jack, *see* *Scomberoides tol*
 Legumes, correlation between the seed and straw production of some field, 83
 Leguminosae, 551
Leersia hexandra, 137
 culture and cost of production, 137
 fertilization, 144
 plantation, site for, 138
 planting, 138
 preparation of field for, 138
 weeding, 142
 LEONCIO, MARTIN O., cited, 97
 LEONARD, W. A., cited, 166
 Lepidoptera, 397
 Lethal temperature
 determination of, 540
 for weevils, 537
Leucaena glauca, 21, 46
 LEUKEL, R. W., JAMES G. DICKSON, AND A. G. JOHNSON, cited, 500
 Liberalization of Philippine Land Law, 387
 Licauc, *see* *Pristopoma hasta*
 Liebig condensers, 510
 Lifting device in recuperative work of trees, 93
 Limestone sheep, 477
 LIMPIADO, LEONCIO M. A comparative study of the growth and development of kids of milking and non-milking does, 625
 LINDSEY, J. B., cited, 165
 LINK, GEORGE K., AND ALICE A. BAILEY, cited, 301, 302
 Litog, *see* *Arca granosa*
Loranthus philippensis, 80

M

MABBUN, PABLO N. Our farm labor supply, 287

MACKAY, A., cited, 368

MAINS, F. B., cited, 46

Maize, *see* *Zea mays*

Malay Peninsula, 551

Malayan Forest Department, 551

Mangifera indica, 89, 90

Mango, *see* *Mangifera indica*

Mango budding, 21

Manlit, *see* *Tridacna cumingii*

MANN, A. R., mentioned, 381, 384

MARIANO, J. G., cited, 28

Mares
grades with Arabian blood 478
polyoestrous, 477

Marine eel, *see* *Muraenesox cinereus*

MARLATT, C. L., mentioned, 384

MARSHALL, FRANCIS H. A., cited, 31, 477, 478

MARSHALL, Chief Justice, quoted, 351

Mayang, *see* *Drepane punctata*

Mean weights of experimental chickens, 513

Measuring instrument for kids, 627

Mediterranean flour moth, *see* *Sitotroga cerealella*

MEDRANA, CONSTANCIO T., cited, 581

Megalops cyprinoides, 258

MEJIA's hacienda at Puerto Bello, Ormoc, Leyte, 467

Melo aethiopica, 126

MENDIOLA, NEMESIO B.
A report of an agricultural investigation trip to Java, Federated Malay States and Borneo, 3
Some possibilities in breeding plants for cover, green manure and shade, 159

MERCADO, TORIBIO
A report on the asexual inheritance of "many-eyed" character of sugar cane, 277
Sugar cane breeding in the College of Agriculture V: Isolation of live cane arrows, and their use for hybridization, 527

MERRILL, E. D., mentioned, 333

Milking does, 625

Milking stand, 626

Milkfish, *see* *Chanos chanos*

MILLER, HUGO H., cited, 295

Millet, 398, 422

Mimosa invisa, 21

MIRASOL, JOSÉ JISON, cited, 607

Miyake, K., cited, 607

Modified Kjeldahl apparatus, 510

Moldboards and shares, scouring by, 487

Monamon, dilis, or anchovy, *see* *Anchovia commersoniana*

MONDONEDO, MARIANO. A comparative study of corn and cassava as feeds for hogs.
II. Ground corn vs. raw chopped cassava, 105

Mono-ammonium phosphate series, cultures of rice seedlings in, 40

Monohammus scutellatus, 538

MONTALBAN, H. R., mentioned, 254

MONTEMAYOR, ZOSIMO. A promising cassava grater for the farm, 593

MORSE, H. J., cited, 188

Mudfish, *see* *Ophicephalus striatus*

Mugil cephalus, 257

Mullet, *see* *Mugil cephalus*

MUMFORD, F. B., cited, 477

Mungo, *see* *Phaseolus aureus*, also *Phaseolus mungo*

MUNRO, R. W., AND L. C. BROWN, cited, 223, 233

Muraenesox cinereus, 257

Murex capucinus, 126

Murex ramosus, 126

Musa chilliocarpa, 21

Mycobacterium tuberculosis, 169

N

Napier grass, 600

NAVARRO, ANDRES, cited, 398

Nemipterus sp., 258; *Nemipterus japonicus*, 258

Nerita, 127

New College copra drier, 467

New Era Cowpea, *see* *Vigna sinensis*

NICHOLS, H. A. ALFORD, cited, 593

Nicotiana tabacum
alafug, 568
asparagin of, 565
benzene extract of, 566
burning quality of, 566
carbohydrates of, 565
certain definite qualities in, 565
changes that take place in curing of, 565
color of, 566
Connecticut Havana, 568
dry weight of, 565
experiments, inquiry on, 11
improved Gold Leaf, 568
leaves, Isabela and Cagayan, 567
Los Baños, 568
nature of the aromatic substances in, 566
nicotine content of, 565
nitric acid of, 565
phenols of, 566
quality of, 565
relation between quality and chemical characteristics of, 566
Texas Cuban, 567

O

Occidental Negros Carnival, 110

Oil, ethereal, 565

Oil, west Africa palm, 91

Onion, *see Allium cepa*

Onion bulb rot, 301, 647

Ophicephalus striatus, 257

Ophiobolus heterostrophus, 503

ORDOVEZA, RAMON C. The culture and cost of production of barit in Bay, Laguna, 137

Organic acids, salts of, 565

Organization, system of farm, 2

Oryza sativa, 22

effect of changing moisture content of soil upon, 173

effect of nitrate and sulfate of aluminum on, 611

effects of treatment upon the upland and lowland, 179

external appearance of, 176

improvement of, 12

inbreeding of, 11

number of days to maturity of, 175, 178

plants

air-dry weights of straw and grains of, 175

average height at harvest, 175

dry weight of, 610

effects of aluminum salts added to good and poor culture solutions, 612

physical and anatomical methods of selecting, 13

single-salt stock solutions, 37

solutions, culture, for young rice plants aluminum salts, 609

four-salt solutions, 609

preparation of, 38

3-salt complete, 37

station, Biggs, 580

straw and grain from first planting of lowland set of, 177; of upland set of, 170

straw and grain from second planting of lowland set, 178. of upland set, 177

varieties of, 581

Inintiw, 174

Kumpol, 174

yields, 583

Ostrea orientalis, 126

Our farm labor supply, 287

Oxyurichthys ophthalmonema, 256

Oyster, *see Ostrea orientalis*

P

Paco, *see Pteris quadriaurita*

Paddies, preparation of, 581

Palad, *see Pseudorhombus neglectus*

Palaemon

lanceifrons, 96

sundaicus, 126, 130

PALISOC, E. Comparative nutritive values of different salts of ammonium, 37

PALLER, ENRIQUE M. The effects of dry heat on weevils in corn and corn seeds, 537

PALO, MACARIO A. A *Fusarium* causing bulb rot of onion in the Philippines, 301

Palos, *see Muraenesox cinereus*

Panicum spp., 398, 422

PANTALEON, FELICIANO T. Effect upon rice plants of changing the moisture content of soil, 173

Paserocean

breeding work in, 19

sugar cane experiment station at, 5, 16, 18

Patanang, *see Murex ramosus*

Peanut, *see Arachis hypogaea*

PEARL, R., AND F. M. SURFACE, cited, 29

PEÑA, JUAN. The effect of borders in farm crops experiment, abstract by CLEMENTE E. YANGO, 385

PELTIER, GEORGE L. A research delusion, address, 473

Pen and feed rack, 626

Penaeus sp., 130

PEÑA, MARCELO B. Corn production as affected by some common manures, abstract by FELIX N. CAMBA, 323

PERALTA, FERNANDO DE. Third list of cyanophoric plants of the Maquiling region, 333

Pestalozzia palmarum, 223

morphology of, 224

mycelium of, 224

pathogenicity of, 229

physiology of, 227

taxonomy of, 232

PETIT, R. H., cited, 422

PFEIFFER, T., A. RIPPEL, AND C. PROTENHAUER, cited, 176

Phaeogenes planifrons, 398

Phaseolus areus, 83

varieties of, 84, 86

Phaseolus calcaratus, 83, 86

Phaseolus mungo, 188

Philippine farmers' tax guide, 351

Philippine flowering plants, an enumeration of, 333

Philippine forests, 551

Philippine shell fish, proximate chemical analysis of, 125

PHILIPS, A. G., R. H. CARR, AND D. C. KENNARD, cited, 103

PIATNITZKI, M., cited, 566

Pineapple, sweetest varieties of Java, 22

Pinna virtata, 128

Pigs

Berkshire, 369

care and management of, 370

feeding of, 370

observations on, 370
 weighing of, 370
Pioneering work, 325
Pisang sewoe, *see Musa chilliocarpa*
Plant breeding and improvement of some of the most valuable species now under cultivation, 160
Plant introduction from Java, 22
Plants
 breeding for cover, green manure and shade, 159
 cyanophoric, of Maquiling region, 333
Platycephalus indicus, 255
Plow
 Chattanooga, reversible disk sulky, 188
 John Deere, 492
 Luzon Lagio—single-animal steel, 168
 Native, 187
 Prairie Queen Breaker, 188
 stubble, 188
Plow and shares, tillage implements, 487
Plowing under legumes by single animal plows, 187
 field used, 189
 legumes used, 188
Plowshares, 494
 forged, 491
 maintaining suction of, 487
 methods of testing, 492
Poisonous insects, bites of, 383
Pomadasis argyreus, 256
Pompano, *see Caranx malabaricus*
Porgy, *see Sparus calamara*
Poultry
 epidemic, notes on an outbreak of, 263
 use of, 511
Power of taxing the people and their property, 351
Practical Poultry Farming, a review of, 201
Preparation of scientific and technical papers, note on, 326
Pristopoma hasta, 256
Progressive Japan, 221
Pseudorhombus neglectus, 256
Pteris quadriaurita, 127
Public land
 caution to applicants for, 326
 developing a piece of, 206
Puccinia coronifera, 46
Puccinia sorghi, 46
Pullets, Cantonese, 96, 512
 feed and feeding of, 96
 flock of, 96
 house for, 96
Pummelo, 21
Pumao, *see Tapes striatus*
Pusit, 130
Pyrilidae, 397

Pyrilis glabralis, 397
Pyrausta nubilalis, 397
 adult female, 409
 adult male, 402
 alternate hosts, 422
 annual number of generations, 417
 control, 426
 enemies of larvae, 422
 enemies of pupae, 423
 fifth instar larva of, 414
 first instar larva of, 416
 fourth instar larva of, 415
 geographical distribution of, 398
 life history and habits of, 417
 pupa of, 410
 seasonal occurrence and abundance of, 421
 susceptibility of different corn varieties to, 422
 synonyms, 397
 systematic position of, 397
Pyrethrum flowers
 exports of, 154
 highest yield of, 153
 in Japan, production of, 153
 local consumption of, 154
 quality determined by soil content, 153

Q

Quinine, *see Cinchona*

R

Ranching on the slopes of Taal volcano, 156
RAMOS, José C. Notes on yield of some species of coffee grown on the College farm, 317
RAMSOWER, H. C., cited, 487, 488
Ratio between
 soilage consumption and weight of horses, 605
Rations, normal egg laying, 26
Real property
 assessed valuation of, 351
 assessment of, 352
 calendar for farmers, 358
 forms, 359
 levy and disposition of proceeds of, 352
 redemption of, 355, 357
 tax, 351
Real weights of birds, 513
Recuperative growth of plants, 89
REDDY, C. S. AND J. R. HOLBERT, cited, 500
REDDY, C. S., J. R. HOLBERT, AND A. F. ERWIN, cited, 504
REINKING, OTTO A., cited, 233, 499
Repollo, 568
RESANANDA, NAI THONGDEE, cited, 27
Rhode Island Red eggs, 561
RICAFRENTE, QUIRINO P., cited, 580

Rice, *see Oryza sativa*

RICHMOND, G. F., cited, 167

RIDGWAY, ROBERT, mentioned, 310

RIVERA, BONIFACIO DE, cited, 165

ROA, MANUEL A. A word of comment on
Gordon's gravity gate, 319

ROBB, WALTER, cited, 293

ROBERTSON, RALPH D., cited, 579

Rockefeller Foundation, fellows of the, 3

RODRIGO, P. A.

cited, 519

Studies on the correlation between the seed
and straw production of some field
legumes, 83

Yielding power of peanuts from cuttings
of different ages, 519

Roselle, 22

ROXAS, Doctor MANUEL L.: An appreciation
by B. M. GONZALEZ

ROXAS, MANUEL L.

cited, 253

mentioned, 197

Rubber breeding, 16

improvement of, 14

RUGG, W. C., AND W. O. PEDERICK, listed, 33

RUSSELL, H. L., mentioned, 4

RYNDERS, G. W., cited, 490

S

SACAY, FRANCISCO M. An age of insects, not
of man: Some notes of the Fourth Interna-
tional Congress of Entomology, 381

Saccharum officinarum

age of plants potted, 531

branching of, 277

bud variations, 277

cane hybridization, 527

care and treatment of potted arrows, 533

checkboard planting of, 533

crossing, 531

double eyes of, 278

experiment station, 5

eyeless node of, 277

eyeless top of flowering stalk of, 279

field germination test of "many-eyed"
variety versus Luzon White, 283

germination of the eyes of, 277

germination test of, 279

germination under nursery conditions, 281

healthy stalks, 528

hereditary behavior of single and multiple
eyes of, 281

hybridization operations, 527

Jeswiet study of hair groups of twin eyes
of, 284

many-eyed character of, 277

mother plant, 531

multiple eyes of, 278

number of seedlings produced, 531

parentage of one, two, and three visible
eyes in each stalk, 280

planting, checkboard system, 530

potted arrows, 533

potting, 528, 533

recumbent stalks, 528

stalk with eyes on each node at right angles,
277

stalk with short joints, 277

tillering habits of, 531, 532

varieties of, 527

SAIKI, TADASU, mentioned, 215

Sample, bumping, frothing, and boiling over
of, 509

SAMPSON, HUGH CHARLES, cited, 163, 164,
167, 233, 361, 362

SANTIAGO, MOISES S., cited, 95, 96

SANTOS, ADRIANO V. A review: Commercial
timber trees of the Malay Peninsula, 551

SANTOS, FRANCISCO O.

cited, 95

The Japanese Imperial Government Insti-
tute for Nutrition, 215

Sardine, *see Sardinella longiceps*

Sardinella longiceps, 258

Scatophagus argus, 258

SCHMUCK, A., AND BALABUNA POPZWA, cited,
566

Schools, specialized, 1

SCHULTZE, W., cited, 398

Science

the main business of, 331

on the advancement of, by published
papers, 395

Scomber japonicus, 256

Scomberoides tol, 257

SEALE, ALVIN, cited, 126, 129, 254

Seeds, vegetable, germination of, 452, 453,
454, 457, 458

Seeds, bean

acceleration of destruction of, 539

destruction of germination, 539

Seeds

lettuce, germination in sand, 454

pechay, germination in sand, 453

Seed bed and seedlings, 581

Serdang

public garden at, 5

experiment station at, 5

SERRANO JOSÉ A. A comparative study of
the effect of copra meal and dried shrimps
as supplements in rations for laying hens, 95

Shares, plow

chilled cast iron, 490

chromium plated soft center steel, 490

Krupp steel, 490, 491

- Sheep**
 Australian merinos, 477
 Dorset horned breed, 477
 Indian sheep, 477, 478
 mutton, 477
 the trend of reproductive seasons of, 482
 wild goats, 478
 SHERBAKOFF, C. D., cited, 310
 SHIVE, J. W., cited, 37
 SHOBER, J. B., cited, 166
 Short courses in agriculture, 211
 policies of, 211, 212
 Shrimp, salt water, *see* *Penaeus* sp.
 Shrimps, *see* *Palaemon lancifrons*
Silvanus surinamensis, 538
 SILVESTRI, FILIPPO, mentioned, 382
Silotroga cerealella, 535
 Smith Hughes high schools, 212
 SMITH, WILLIAM, cited, 368
 Snapper, *see* *Nemipterus japonicus*
 SNYDER, E. F., cited, 383
 SNYDER, MORTON. The tragedy of the unfit, 332
 Society, needs of, 1
 Soilage, consumption of, 601, 603, *see also* zacate, 599
 Sorghum, 398, 422
 SORNAY, P. DE, cited, 188
 SOUTHCOMBE, J. E., AND HENRY M. WILLS, cited, 165
 Soy bean, *see* *Glycine hispida* and *G. max*
Sparus calamara, 258
 Species and evolution, 383
 SPENCER, M. LYLE. What a university should do for its students, 59
 SPENCER, S., cited, 367
Sphyraena acutipinnus, 254
Sphyraena jillo, 254
 SPIERS, S., AND J. L. BITTE, cited, 165
 SPILLMAN, W. J., cited, 83
Staphylococcus
 albus, 264
 aureus, 264
 STEVENS, H. P., cited, 166
 STEWART, J. H., AND H. ATWOOD, cited, 368
 STILES, G. W. JR., cited, 125
 STOCKDALE, B. A., cited, 223, 232, 233
 STOCKLASA, J., cited, 608
Strombus canarium, 126
 SUERTE, DELFIN. The composition of commercial sugar from Philippine centrals, 149
 Sugar cane, *see* *Saccharum officinarum*
 Sugar, composition of commercial, 149
 SULIT, VICTOR S., cited, 95, 166
 Sulfuric acid, salts of, 565
 SUNDARASINHA, CHARAS S. Plowing under legumes by the use of single-animal plows, 187
 Sunog, *see* *Platycephalus indicus*
 Survey of Land Grant Colleges, 269
 Susong tabang, 127
 Susong dagat, *see* *Cerithium vertagus*

T
 Taktakin, 121
 Talakitok, *see* *Caranx malabaricus*
 TALEON, ALEJO T., cited, 103
 Talitap-ong, *see* *Murex capucinus*
 Tamban, *see* *Harengula moluccensis*, also *Sardinella longiceps*
 Tapalang, *see* *Cyrena gigantea*
Tapes striatus, 129
 Tarpon, *see* *Megalops cyprinoides*
Tax
 collection of, 357
 excise, 351
 exemption from, 353
 farmer's income, 355
 fraudulent returns of income, 356
 liability, 355, 357
 levying and collecting, 351
 payer, delinquent, 355, 357
 paying population, 357
 rate of, 357
 Taxes, business, 351
 Taxpayer, rights and privileges of, 357
 Teacher, problem of agricultural, 1
Tellina incerta, 129
Tenebrioides mauritanicus, 538
 TEODORO, A. L., cited, 189, 190
Tephrosia in coconut planting, 204
 Testimony, 332
 The measure of a man, 116
Therapon puta, 258
 Tihangca, *see* *Nerita*
 TIGLAO, SIMPLICIO. The relation of rainfall to the production of corn, abstract by SEVERINO L. SALVADOR, 466
 Tihim, *see* *Tellina incerta*
 TILLYARD, R. J., mentioned, 382
 Tinikan, *see* *Anabas testudineus*
 Tiny wasp, an ally of man against cane borer, 382
 TISDALE, W. H., I. W. TAYLOR, R. W. LEUKEL, AND MARION A. GRIFFITHS, cited, 504
 Tjinjirean, Cinchona Experiment Station at, 5, 16, 17
 Tobacco, *see* *Nicotiana tabacum*
Tractor
 Fordson, 492
 Samson, 492
 Tragedy of the unfit, 332
Tribolium confusum, 537, 540
Tridacna cumingii, 128
 Trip to Java, Federated Malay States and Borneo, agricultural investigation, 3

Tropical forestry, 551

Tunggo, *see* *Oxyurichthys ophthalmonema*

Tunsoy, *see* *Harengula motuccensis*

Tuyo, or dried fish, 267

U

UHL, A., AND W. KESTRANEK, cited, 337

Umbrina russelli, 255

Unbalanced diet, influence of, 216

V

VELMONTE, JOSÉ E. Philippine farmers' tax guide, 351

VENKATRAMAN, T. S., AND R. THOMAS, cited, 527

VENTURA, GAUDENCIO A. Studies on the germination of vegetables seeds, 451

Vigna oligosperma, 21

Vigna sinensis, 83

VILLA, FELIX. Effect on young rice plants of adding aluminum salts to complete culture solutions, 607

VILLEGAS, VALENTE

cited, 478

The trend of sexual and reproductive seasons among horses, cattle, water buffaloes, sheep and goats under Los Baños conditions: A preliminary report, 477

Zacate and water consumption of Philippine horses, 599

VISTA, T., cited, 361

Vocational teachers of Agriculture in North Carolina, 275

VON UFFEL, H., cited, 167

VRIES, O. DE, AND E. SIDENIUS, cited, 566

VROOMAN, CARL, mentioned, 269

W

WADE, J. S., cited, 398

WALKER, J. C., cited, 315

WALKER, J. C., AND E. C. TIMS, cited, 301

WALKER, J. E., cited, 164

WOLLENWERER, H. W., C. D. SHERBAKOFF, O. A. REINKING, HELEN JOHANN, AND ALICE A. BAILEY, cited, 310

Water

consumption of Philippine horses, 603

extracts, 570

for Philippine horses, 601

gauge, 582

Weanlings, 513

Weed eaters, employing, 382

Weeds, eradication and controlling, 160, 537

Weevils, grain

Bruchus quadrimaculatus, 539

Bruchus obtectus, 539

lethal temperature for, 542

What a university should do for its students,

59

WHEELER, W. P., cited, 368

White louse, 20

WILLIAMS, C. G., AND J. B. PARK, cited, 83, 86

WOODWORTH, H. E., cited, 422

Y

YAMAO, S., cited, 608

Z

Zacate, 599

Zea mays

Australian Yellow Dent, 540

baluga, 540

breeding, 13

Calauan Yellow Flint, seed-borne flora of, 499

Cagayan Yellow Flint, 540

Cebu, 540

damage by corn borer to, 397

Diplodia-infected kernels, 500

Diquet, 540

Ferguson, 540

fodder, 600

grains, 537

improvement, ear-remnant method of, 12, 13

kernels, treatment of

copper carbonate dust, 537

copper

colloidal, 500

sulfate, 500

Corona 640, 500

Corona 640-S, 500

Derris powder, 500

Dipdust, Bayer's, 501

Dust, Bayer's, 500

formaldehyde, 500

Germisan, 500

Improved Semesan Jr., 500

mercuric chloride, 500

organic mercury compounds, 500

special dust, 501

Uspulun, 500

inbreeding of, 11, 13

Los Baños Yellow Dent, 540

molds of, 501, 504

Moro, 540

pop, 540

productivity, 537

production, 13

as affected by some manures, 323

seeds

effect of dry heat on, 542, 543, 546

sweet, 540

viability, 537

vitality, 537

Zenillia roseanae, 398

Volume XVI

Number 1

The Philippine Agriculturist

(University of the Philippines Publications: Series A)

June, 1927

The Dean Replies	By <i>Charles Fuller Baker</i>	1
Education and Agricultural Promotion in Japan: III. Research Work	By <i>B. M. Gonzalez</i>	3
Lowering Cost of Rice Production	By <i>M. B. Raymundo</i>	9
Growing Peanuts from Cuttings	By <i>P. A. Rodrigo</i>	13
Study of the Tobacco Growers' Association Inc. of Tuguegarao, Cagayan	By <i>Pablo N. Mabbun</i>	19
The Cost of Raising Pullets under Conditions existing in the College of Agriculture	By <i>Pedro S. Paje</i>	35
Note: Los Baños Biological Club		49
Abstract: Study of the Root System of Rice	By <i>Simplicio Oliveros</i>	53
Exchange Notes		55
College and Alumni Notes		57

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S1
P62

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Vocational Education	By <i>B. M. Gonzalez</i>	1
A Report on an Agricultural Investigation Trip to Java, Federated Malay States, and Borneo	By <i>Nemesio B. Mendiola</i>	3
The Seasonal Distribution of Egg Production: The Normal Egg Production Curve	By <i>F. M. Fronda</i>	25
Comparative Nutritive Values of Different Salts of Ammonium	By <i>Eleuterio Palisoc</i>	37
Note: Introduced Coffees Lose Resistance to <i>Hemileia Vastatrix</i> Berkeley and Broome	By <i>Pedro A. David</i>	45
Extension Division Notes		51
Exchange Notes		53
College and Alumni Notes		55

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